THE VINE IN AUSTRALIA:

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P R E F A C E .

THE general interest shewn at the present time in these colonies in the cultivation of the vine and wine growing has induced the author to place before the public the following observations, the result of twelve years experience as a wine grower in Australia.

The present volume is addressed principally to those who are imperfectly, if at all, familiar with vine culture; and to render the text more clear, numerous illustrations of the mode of its cultivation, as well as of the process of wine making, have been introduced. The author's first attempts having been followed by the failures and disappointments which invariably accompany early essays in a new and untried field of enterprise, he would fain hope that he may be enabled to save those, who would now enter upon the same pursuit, the price, no small one, at which his experience was bought.

The indefatigable perseverance which established the vine in New South Wales, and the experiments of the first cultivators there, made our path a comparatively easy one, but we were not then aware of the peculiarities of our climate, and many mistakes were the consequence of want of knowledge on this subject. A recent tour in the wine districts of New South Wales has considerably extended the sphere of the writer's observations, and the information so readily communicated by the wine growers of that colony has enabled him to place before the reader many interesting and practical matters. To Sir William Macarthur especially, is he indebted for many valuable particulars connected with wine growing, deduced from his own experience and also from observations made during his late visit to the wine districts of Europe. To the same gentleman, also, he owes the rough notes interspersed throughout these pages. These notes were appended to one of the seven competitive essays for the prize offered by the Geelong Agricultural Association. This essay, rejected by the other judges, Sir William considered the best, notwithstanding its many faults, and on returning it

he added the notes, which were intended to correct its errors and supply its omissions. There is no breach of confidence in the publication of these notes as they were put into the writer's hands with full liberty to make what use of them he might.

The first principles of vine culture and wine making are the same in Australia as in Europe, and the most recent views of French and German writers have been sought for in their latest publications. It is unfortunate that those portions of Europe which, in their climate, resemble the warm districts of these colonies, have furnished nothing to the stock of literature. In vain we look to Spain or Portugal for the information we require. The choice gifts of bountiful nature in these lands receive little care or attention from man, our only knowledge of the products of their luxuriant vineyards being limited to the artificial compounds supposed by the British to be the only wines of those countries.

The principles of fermentation have been dwelt upon at what may be regarded a tedious length, seeing that the conversion of grape-juice into wine is a perfectly natural process. But a knowledge of the artificial processes of fermentation will be found of essential service to the wine grower, who, if he trust to the routine of European practice, may often find himself at fault, in the new and altogether different circumstances in which he is placed in these colonies.

The confusion arising from the constant repetition of the word Australia as applied to these colonies, separately and collectively, has induced the substitution of the name of the Capital of the Colony for that of the Province of South Australia. There can be no doubt about the locality meant when Adelaide is mentioned, but South Australia naturally calls up, in the minds of strangers, the most southern of these colonies—Victoria.

CHAPTER I.

INTRODUCTORY.

In the extensive dominions of Great Britain, embracing every variety of soil and climate in Europe, Asia, Africa, and America, nearly every product that can minister to the wants of civilized man is produced, with the exception of wine, and for this she has to depend on foreign countries. The poor coarse wine hitherto supplied by the Cape of Good Hope need hardly be taken into account.

For her supply of wine Britain needed not to go far. Across the English Channel, at her nearest neighbours, she could purchase the purest and best wines in the world, and at a reasonable rate. But with singular perversity John Bull refuses to deal at the nearest shop where he can get the article he wants, he prefers passing on to an inferior one where there is a poor choice of inferior articles, and thus goes further and fares worse.

This perverse conduct on the part of that very obstinate individual would be laughable were it not for the lamentable results of his absurdity in the vitiated tastes and degraded habits engendered by the habitual use of coarse and heavily intoxicating drinks. It has long been the policy of the British Government to suppress the importation of French wines. The strong coarse wines of Spain and Portugal were for many years admitted into Britain at a much lower duty than the light wholesome wines of France, and although the duties have since been equalized, the habit of drinking strong branded wines and their counterfeits have so vitiated the tastes of the people that a pure wine would not be relished by the majority of the British.

To such an extent was the interference with the best interests of the people carried at one time, that we find in the year 1717 the duty on French wine was £55 per tun, while Portuguese wine was admitted at £7 5s. 3d. Such continued to be the wretched policy of the old country for more than a century, and although some modifications were made from time to time in the relative duties, it was not until a comparatively recent period that they were equalized by being reduced to 5s. 6d. per gallon on all foreign wines and 2s. 9d. on colonial.*

The habit of drinking strong sweet wines engendered by this mistaken policy has gone on increasing to such an extent that the original pure wines of Spain and Portugal are now too dry for the general taste. Sweeter and stronger wines have been brought forward and have found favour. Artificial means have been devised to heighten the qualities for which they were prized; and the art of the compounder has reached such a point, that little or no grape juice is required to fabricate the wretched compounds which are sold under the names of Sherry and Port. Those wines even, which are supplied direct from the countries in which they are grown, are already manufactured to suit the taste of the consumer, for the sophistication has commenced before they have left their native shores; whatever ulterior doctoring they may receive in Britain. "Five-eighths of the Oporto wine brought to Britain," says Redding, "is so coarse, and in such a medley of ill-flavoured and heterogeneous vine produce, that any ingenious person may increase one pipe to three by the addition of unexciseable articles, without any fresh injury to the stomach of the consumer, or to the appearance of the wine happening."

Had it not been for the vitiated taste induced by the use of such wines, the coarse productions of the Cape would never have found their way to England. The very inferior quality of Cape wines in general is ascribed to the inveterate

propensity of the Dutch farmers to look to quantity rather than to quality of produce. The coarsest and most productive varieties of vine planted in the richest soils and forced by rank manures, yield large crops of fruit, which, after a most slovenly-conducted fermentation, produce a quality of wine of the lowest character. This is a state of things much to be deplored, for nature had no share in these miserable results. "In no country," say the writer quoted above, "is there more room for greater improvement, nor is there any in which care and science properly directed would earlier exhibit their effects. Except a soil consisting of volcanic remains, there are traces of every other kind of land congenial to vine culture; and there can be no doubt that were vineyards planted on sites more suited to their growth, and the grapes selected with due care, a vast deal of good wine might be sent from thence to Great Britain."

Since the foregoing was written considerable improvement has taken place in the wines of the Cape; but such is the bad odour which surrounds even the name of Cape wine, that it is found necessary to introduce it under the new appellation of South African wine. The example of the Cape ought to be a beacon and warning to the Australian colonies now entering upon the same career. Two of these have made considerable essays in wine growing with results of the most encouraging kind, which have raised the hopes of their friends at home that they may at no distant date become wine exporting countries. In Victoria also the beautiful vineyards of the Barraboo Hills are an earnest of the future wine growing of that fertile land.

The capability of these colonies for producing wines of first-rate or even good quality, is little understood by the majority of the colonists themselves. The few who are sanguine, have a hope and confidence based on as firm ground as the faith of the small minority who twenty years ago maintained that Australia would be one of the finest wheat growing countries in the world. The great Exhibition of 1851, showed the triumph of Australian agriculture; and now the prospects of wine growing in the Australian colonies are much more hopeful than wheat growing ever was or perhaps is now; and when we compare our soil and climate with those of the wine countries of Europe, we are warranted in coming to the conclusion that the future of the wine growing interests in Australia is as promising as any of her permanent resources. But we have something more tangible than mere hopes, though based on the soundest inductions, on which to build our faith of the future wine growing interests of Australia.

As the eldest colony, New South Wales took the lead in wine growing, and produced samples which have been brought into comparison with first-class wines in Europe, and have stood the test of that ordeal. Adelaide, following in the wake of the elder colony, has imported thence the varieties suited to the Australian climates, as well as the best kinds grown in Spain, and is now producing wines which would be a marketable commodity in any part of the world. Victoria, from her more immediately productive resources, first, of the wool of her extensive rich pastures, and subsequently, of her gold fields, has paid less attention to agricultural and horticultural pursuits. There are various

localities of that colony whose adaptability to wine growing has been years since satisfactorily tested by settlers whose experiments did not extend beyond producing wine for domestic use; and although these experiments have not been followed up by a more extended culture of the vine, the time is not far distant when her active and rapidly increasing population will betake themselves to agricultural pursuits, and eventually to wine growing. The result of the enterprise of the Swiss settlers at Barrabool, is an earnest of what may result from the extension of vine culture to her various localities, presenting every diversity of soil and climate.

The obstacles which lay in the way of those who first attempted to introduce the vine from Europe can hardly be understood by the recent settler, who has no difficulty in procuring cuttings of all the best varieties grown in Europe and now acclimatized in Australia. He would much more appreciate the great advantage he enjoys, did he but surmise the disappointments which they had to meet, who first attempted to introduce the vine into these colonies, and might feel some degree of obligation to those who, by their perseverance, secured to him these benefits.

To the Macarthurs in particular do we owe a debt of gratitude, in the first place, for their arduous attempts to introduce the best varieties of vine, and subsequently for the liberality with which they have communicated the results of their experiments in wine making to the public. When we read the introduction to the "Letters on the Culture of the Vine, &c., by Maro," we there learn the galling disappointments and discouragements which they met in their attempts to bring vines from Europe. At the conclusion of the war in 1815, Mr. Macarthur, senior, with two of his sons, traversed on foot the greater part of the wine districts of France and Switzerland, for the express purpose of collecting vines and obtaining information regarding their culture. The collection of vines thus made arrived in due time in Sydney, and threw well. But after waiting several years for their bearing, they had the extreme mortification to find that they were almost all worthless and utterly unfit for wine or any other useful purpose. By the carelessness or knavery of the parties through whom they were transmitted to the colony, these wretched kinds were substituted for a collection of the best varieties grown in France; and another collection made at Madeira, instead of comprising seven distinct sorts was found to consist of only one, and that one utterly useless. How cruel and heart-sinking must have been this frustration of all their hopes and expectations. The labour of years was thus thrown away, but although on several other occasions, spurious varieties were substituted for genuine kinds, the ardour of the pioneers, though somewhat damped, was not quenched; and their efforts, with those of the Australian Agricultural Company, Mr. James Busby, and others, have resulted in the Australian colonies now possessing most of the best varieties grown in Europe. More than five hundred varieties of the vine were brought from France by Mr. Busby, at his own expense, and deposited at the Botanical Garden in Sydney. These were mostly from the great national collections of Montpellier and the Luxembourg. The best portion of his importations, however, consisted of a small selection made by himself in the wine districts of the south of France and Spain. The experiments made in New

South Wales, in a great diversity of soil and situation, have fully tested the suitability of many of these varieties to the climate; while the flattering testimonials given at the French Exhibition for some of the Camden wines, and the eulogiums of Leibig and others, on the wines of Irrawang, excited a great interest in Europe; and a hope was entertained that the vine in Australia might escape the scourge which then threatened to annihilate it in the old world, and that Britain might thus depend upon her colonies at the Antipodes for her supply of wine. These expectations, however, as to a supply of wine, were premature. Wine growing is still in its infancy here, and vineyard extension, even under the most favourable circumstances, is a work of time; and although Australia has escaped the blight so injurious to the vine in Europe, another obstacle of a serious nature came in the way, which temporarily crushed her efforts in wine making, and in some cases caused the abandonment of vineyards already in bearing. This was the abstraction of nearly all the labour of these colonies by the gold diggings.

Amidst the overturns and changes in our internal industry caused by the gold discovery, perhaps no interest has suffered more directly than vine growing. After many years struggle through unwonted difficulties, vine culture had begun to take its place as one of the permanent resources of Australia, when the attractions of the precious metal, in 1852, drew away from their industrial pursuits nearly the whole of the working population of these colonies. For a time it appeared as if the plough itself were to be abandoned, and our fertile agricultural lands were again to revert to their primitive state of pasture lands. There was for a time, a suspension of all ordinary industrial pursuits, and the eight years that have elapsed since the gold discovery have brought little change for the better in the habits of our working classes.

The demand for food, to supply the wants of a rapidly increasing population, raised the price of bread stuffs sufficiently to enable the farmer to pay the large demands of the labourer. But there was no similar increase in the value of the produce of the vine, except in cases where the fruit was in demand for eating; hence the great falling off in the extent of vineyards and their produce in New South Wales, as shown in the statistical returns :-

Returns of the Vine Cultivation of New South Wales, from 1848 to 1859.

YEAR. ACRES. GAL. WINE. GALS. BRANDY.

1848 88 79,700 1,163

1849 96 95,843 1,226

1850 1069 111,015 1,958

1851 1060 84,843 1,641

1852 1096 92,744 1,581

1853 962 57,491 1,587

1854 913 57,959 674

1855 1030 115,614 1,426

1856 1018 95,645 1,547

1857 1128 108,174 1,414

1858 1179 58,000 —

1859 1221 99,000 —

Victoria and Adelaide Tables.

N. S. WALES. ADELAIDE. VICTORIA.

Acres. Acres. Acres.

1850 1,069 282 164

1854 913 409 162

1856 1,018 753 207

1858 1,179 1,626 401

1859 1,221 2,201 547

From the accompanying tables it appears that the cultivation of the vine has progressed in Adelaide notwithstanding the difficulties in the labour market, which have been fully greater than in New South Wales. In the latter there was a decided falling off for some years after 1852; in fact in 1854 there must have been 183 acres of vineyard totally abandoned, out of 1,096 in cultivation two years previous. The few last years have seen a revival of vine culture in New South Wales, which will, no doubt, go on steadily increasing its vineyards year by year. In Adelaide, although vine growing received a check from the gold diggings, there was, notwithstanding, a steady progression which has added year after year to the extent of her vineyards. The cause of the difference between Adelaide and New South Wales in this respect is to be sought, not in any superiority of soil or climate of one over the other, but in the different circumstances of the proprietors of the land in the two colonies. In New South Wales, the land is held in large portions by the proprietors; while, in Adelaide, it is chiefly in the possession of the working agriculturists, who hold it in moderate portions of 80, 160, or 320 acres. In New South Wales, the large proprietor cultivated his vineyard, as he did his garden, for amusement; and when he experienced a difficulty in procuring labour to work it properly, he could afford to let it go to waste. The Adelaide vine grower, on the other hand, depended on his vines, either partially or solely, for his subsistence, and could not afford to let his property go to ruin, for want of a little care and extra labour; he therefore worked a little harder and later, and managed to keep his vines in passable

order. Where the vine has maintained its ground in New South Wales, it has almost invariably been under similar circumstances to those of the neighbouring colony, where the proprietor was dependant upon its produce for his living.

Another very great obstacle to the progress of vine-growing in the Australian colonies has been, the want of merchants to take the wine off the growers' hands after the fermentation is over. Wine requires much care and attention in the cellar before it is fit for use. This involves time, labour, and skill, along with ample cellar accommodation, all of which ought to be provided by the wine merchant, whose peculiar province it is to take charge of the wine after the fermentation is completed, and prepare it for market. The last operations, the preparation for use, the bottling, &c., are the business of a third party.

The Australian vine grower has been obliged to undertake all these duties, with what satisfaction to himself or others any one may guess. Who can imagine a farmer, after he has grown, harvested, thrashed, and bagged his wheat, being obliged not only to grind it, but also convert it into bread before he can sell it.

The care required by wine in the cellar during the first two years is so incessant, that unless a man can attend to the wine alone, it is hardly possible to do justice to it. While following other avocations—pruning and working the vineyard, sowing and reaping his crops, if he mix ordinary farming with vine culture—the cellar is apt to be neglected, to the injury, or it may be, the ruin of its contents. That this has happened with much good wine in these colonies is notorious; in fact, this may be said of nearly all bad wine, that it owes its ruin to neglect in the cellar.

Where the grower has given due attention to the cellar, and successfully performed the duty of the merchant by producing a good, sound, ripe wine, he has found in most cases, a difficulty in getting some one to undertake the sale of it. The public have complained, with good cause, that they cannot procure the native wines. Neither from the wine merchant nor the publican can a bottle of Colonial wine be had, and during the exhaustion of a hot day with the temperature 95° or more in the shade, the labourer in town or wayfarer on our dusty roads cannot procure one drop of pure wine to recruit his exhausted energies. He can have plenty of heady beer and fiery spirits, but the wine which is grown perhaps within a mile or two of a public house he cannot have.

This is one instance out of many of the tyranny exercised over the public by the holders of a monopoly. In all things connected with the retail of wine, spirits, and malt liquors, the publican is dictator; and the result of his absolute rule is seen in the accommodation the traveller meets with in the country, in the majority of licensed houses. There are some honourable exceptions to the general degradation; but the evil which has grown out of the present system, is one of

the most deplorable that can be imagined, when we look to its effects on the health and morals of the people.

The evils arising from the licensing system are equally felt in the neighbouring colonies. In New South Wales, the vine growers, in order to dispose of their produce, are obliged to have establishments of their own in town for the sale of their wines. In a recent number of the Sydney Herald, we find the following remarks on this subject:—"It must appear strange to those at a distance who hear that wine growing has been carried on in this country for so many years, and has obtained high distinction among connoisseurs, to learn that there is not a single public house in Sydney where the Colonial wine is retailed. Yet, such we believe is the case, as otherwise public attention would be called to the circumstances in the same way as it is to the sale of every other kind of wine or spirit. There is not in fact, amongst the four hundred and twenty-one public houses in Sydney a single place where one can get a draught of the pure juice of Australian grapes, (except as a sample at the wholesale dealers). Many, therefore, who hear Colonial wine talked of, and are anxious to taste it, are not afforded the opportunity. We might suggest that the cafes and principal publicans in Sydney should retail these wines. A quarter cask, or even an octave, might be kept on tap in the cellar, and would remain good for a week or ten days. If sold at the price of the best ale, the profit to the retailer would be nearly equal. Some large parcels of Colonial wine were last year shipped for England, and many of the consignments sold at remunerating prices. But it is to the public of this colony that the wine growers must look for a market for their produce. It stands to reason, that if Australian wine is highly esteemed in England by those who are well acquainted with the best Continental wines, it should, at the least, be as well appreciated here; and that, instead of sending Australian wine to England, and importing thence European wine, it would be more profitable to consume our own wine and save the expense of double freight. We are happy to hear that at all the clubs in this city the Colonial wine is largely consumed; at some of the public dinners it has been introduced, and it is seldom wanting on the table at private dinner parties. There are two direct and palpable advantages to be gained from a more extended consumption of Australian wine. The first and chief of these would be—the substitution of wholesome and refreshing beverages for those which are acknowledged to be more or less exciting and deleterious." The other advantage gained by the consumption of Australian wine pointed out is, "the encouragement of a very desirable branch of industry."

It is much to be regretted that so little advantage is taken of the great facility afforded of increasing the stock of domestic comforts in this country by the addition of pure good wine. The domestic manufacture of such wine, contrary to the prevalent opinion, is a most simple natural process, requiring little or no assistance from art. The British generally consider wine-making a complicated affair. Deterred, perhaps, by the recollection of the difficulties which attended the making of domestic wines in Britain, from attempting wine-making from the grape, they limit their vine cultivation to a few plants in their gardens, where they often produce a superabundance of fruit for the human portion of the establishment and the surplus is generally given to the pigs, cows, and fowls.

There is, perhaps, no fruit so generally relished by animals as grapes. Dogs are the wine growers' great enemies in Europe, and here we find that cows which have once feasted in a vineyard will hardly be kept out by an ordinary fence. It is a good nourishing food for these animals, but surely it might be turned to better account in making a good wholesome beverage for man. There is not a settler or labourer in these colonies possessed of an acre of ground fit for garden, who might not, with a little trouble, grow on a fourth part of that acre as many grapes as would supply, not only enough for eating, but sufficient to make wine for his ordinary wants. The labour and trouble connected with its fermentation is not greater than that required to make common sugar beer; and, a little after care and attention on the part of the housewife, will produce for the following summer's consumption a sound wholesome wine, which will improve the health and gladden the heart. A beverage of this kind would soon take the place of the fiery drinks at present in use, for there is nothing which gains so quickly on the taste as a relish for pure wine. The Australian-born youth, accustomed to such wine, nauseates the coarse wines, beers, and spirits which find favour with the British-born and bred; and even the palate, vitiated by indulgence in such stimulants, readily returns to its primal tastes, when an opportunity is afforded of drinking the produce of the vine for a short time.

The successful results which have attended the cultivation of the vine are evidence sufficient of the perfect fitness of the climate and soil of a vast range of this continent for growing grapes of good quality and great variety. The present state of vine culture, and the persistence with which it has held its ground against the most discouraging obstacles, may lead even those who have hitherto been most incredulous to believe that it may turn out, that most delectable thing, a paying concern. There is now a growing interest in the subject manifesting itself in all the colonies, and prejudice is fast giving way to reason. Already in Sydney there are several establishments for the sale of native wines exclusively, and the Camden, Kaluadah, Cawarra, Irawang, and others, take their place, and successfully compete with the Sauternes and warmer wines of the South of France.

In Adelaide the native wines are steadily gaining ground, and although there, as in Sydney, the popular prejudice opposed their use, and the publicans set their face against them; they have found favour among those who have been in the habit of drinking the pure wines of the Continent, and are best able to appreciate a good sound wine. Many of the Adelaide wine merchants have taken an interest in the progress of wine growing, and have had a pleasure in keeping on sale some of the best Colonial, to offer their customers along with the imported wines. There is one gentleman long known in the wine trade, who has dedicated himself to the sale of the native wines alone.

In the first attempts at wine making by a people to whom the vine was a stranger when they arrived in the colony, it was to be expected that many

failures would occur, and much bad wine be produced. And the Germans, who came from the wine districts of the North of Europe, were here placed in circumstances so different as to climate, from their fatherland, that they had to learn nearly as much as the British, and, what is often very difficult, to unlearn. To our more enlightened German fellow colonists we owe much for the instruction they so readily communicate, and the stimulus which their precept and example has given to this branch of industry; but, at the same time, the labourer, who knows only the routine which he has seen followed in his own limited sphere, is generally wedded to old habits, and not always amenable to instruction. It is generally found easier to instruct an intelligent English labourer in the principles and practice of pruning and vine dressing, than to get an old vine dresser from Europe to give up the system to which he has been accustomed, and which is altogether unsuited to the dry sunny climate of Australia.

At first, little attention was paid to the varieties of the vine suited to the soil and climate of this Continent. Vines from all parts of Europe, and the most diverse climates, were indiscriminately mixed in the same vineyard. A vine from the cold climate of the Rhine or the Neckar was planted alongside of another from the Tagus or Douro. The one ripened its fruit in February, the other perhaps in April, making it impossible to have both ripe at the vintage. Much time was wasted in introducing varieties altogether unsuited to our climate, and which might have been saved by a preliminary inquiry into the nature of our own climate and a comparison with the climates of Europe. There are many acres of vineyard in situations as warm as Adelaide, planted with vines of Northern Europe, which proved so utterly worthless that they have been rooted out after ten years trial, to be replaced by the more vigorous vines of the South of Europe.

To avoid falling into similar errors in future we shall endeavour to take a brief survey of the climatic peculiarities of the different wine producing countries in Europe, and after a similar investigation into those districts in Australia which are best suited for vine culture, we shall be able to compare the climates of the new country with those of the old, and thus arrive at some data on which to proceed in our selection of varieties adapted to different localities.

The necessity for such preliminary investigation is best known to those who are acquainted with the diversities and peculiarities in the habits, form, mode of growth, and produce of the varieties of vine cultivated in different climates; diversities infinitely greater than can possibly be imagined by the uninitiated. The large umbrageous vines of the South of Europe are as unlike the diminutive plants of the Rhine, as the warm generous wines of Spain and Portugal differ from the exquisitely delicate growths of Hochheimer and Johannesberg. Were the varieties of the South transplanted to the Rhine they would pine under the chilly climate, and the fruit, if any, could not possibly ripen. On the other hand, the kinds grown on the Rhine, if taken to Spain or Portugal, lose the fine bouquet for which Rhenish wines are distinguished; they become more sweet and produce a spirituous wine, but the produce is so small that they cannot compete with the

more vigorous and large producing vines which have been found best adapted to such climates.

CHAPTER II.

CLIMATE.

ALTHOUGH the prevailing opinion, that the vine originally came from Persia, is probably the correct one, it must have been introduced into Europe at a very early period of the world's history. It was cultivated in Greece three thousand years back; and when the Romans invaded Gaul nearly two thousand years ago, they found the vine in sites which are at this day famous for their wines in modern France. So completely has the vine become domesticated in Europe during the long period that has elapsed since its first introduction, that we now regard the centre and South of Europe as its habitat. What little is known of the present state of vine culture in Persia, would lead us to believe, that there we need not go for instruction as to the habits of the vine, and the care required in its cultivation.

In Europe, throughout the great variety of climates comprised between latitude 51° at Coblenz on the north, and 34°30' at Cyprus on the south, we find the vine cultivated most extensively in every country from the Atlantic on the west, to the Euxine and Levant on the east. In the immediate range of territory comprised within this area, are grown almost all the choice wines known in commerce. This is in fact, par excellence, the wine district of the world; and here we may study with profit the peculiarities of soil and climate, as well as the varieties and modes of culture of the vine, suited to each climate. The north coast of Africa at one time produced wine of some note, but the Mahomedan races who now inhabit that extensive territory pay little attention to the cultivation of the vine, whose fermented juice they are debarred from tasting.

In the diversity of climate comprised within the limits above stated, we shall find counterparts in the Australian continent, while its various soils and aspects afford sites as favourable for the successful culture of the vine as any in Europe.

Within the tropics the vine grows luxuriantly, but does not naturally produce grapes. In order to cause it to fruit, the vine must have its growth checked by stopping completely for a time, the flow of the sap. In temperate climates this is effected by the cold of winter, but in tropical climates where there is no winter to cause the necessary check, artificial means may be taken to produce it. In India it is done in the following manner: the soil is cleared away from the roots of the vine, so that the leaves wither and fall off as in a natural winter; and after the flow of the sap has been thoroughly checked for a time, the plant receives the

pruning which it requires in the winter of colder climates; the earth is then laid carefully about the roots, and in a short time the vine springs into vital activity with the vigour peculiar to itself, and in a few months yields an abundant crop.

The grapes of warm climates are generally deficient in that delicacy of flavour so essential to the finer wines, but they are rich in saccharine principle, and the rich flavours prized in table grapes. In the colder climates are produced wines of the finest flavours, called by the French bouquet, nose-gay; and such wines have little alcoholic strength. But it does not follow that the finest vines are grown in cold seasons; the contrary is the fact so far as the colder wine countries are concerned. A warm genial season causes the development in the grape of not only the sugar on which the formation of the spirit depends, but also of all the other elements essential to the perfection of the fruit, and its conversion into wine; so that the quantity of sugar or saccharine matter in the grape, comparing one year with another, may be taken as a pretty correct test of the relative quality of the wine in each year. The following table given by Mulder, shows the effect of fine warm seasons upon the quality of the wine, grown on the same vineyard. The column giving the spirit or alcohol in the wines, expresses also the original saccharine principle in the grape, and in consequence its general qualities as already stated.

YEARS. AVERAGE TEMPERATURE. Wine per Acre in Gallons. Alcohol in Wine in volume.

During Culture. Summer. Beginning of Autumn.

1833 58.4 Far. 62.5 55.5 300 5.0

1834 63.1 68.5 62.6 396 11.2

1835 60.4 67.1 54.1 598 8.1

1836 59.1 70.7 53.9 524 7.1

1837 59.3 65.6 53.4 176 7.7

"In the year 1834, when the average temperature during the whole period was highest, the greatest quantity of alcohol was produced: the reverse was the case in 1833 and 1837. The temperature at the end of the summer appears particularly to affect the quality of the wine, and this opinion seems justified by the results of 1811. As a general rule however, a good vintage with regard to quantity does not necessarily involve excellence of wine, for the most productive years are generally those which yield bad wine. It appears, therefore, that quality and quantity are not more intimately connected in the chemistry of the plant than in other cases."—Mulder's Chemistry of Wine.

In order to place before the eye, the geographical position with regard to latitude of the Australian colonies, in comparison with the wine countries of the Northern

Hemisphere, I have borrowed the accompanying illustration from the excellent treatise, by Mr. W. S. Jevous, on the climates of Australia and New Zealand, which appeared in The Australian Magazine of Science and Art. (Map on the opposite page.)

It must be borne in mind, that between the Northern and Southern Hemispheres there is a considerable difference of temperature for which allowance must be made in the comparison. The difference has been variously stated by writers on the subject, but from recent observations we are led to infer that it is by no means so great as was at one time supposed. The line of mean temperature 50° in the south is included between latitudes 42° and 50°, giving a mean latitude of 46°.—(Johnston's Physical Atlas.) While the same isothermal line in the north ascends as high as latitude 54° and descends to 41°, giving the mean latitude 47° 30'. This difference of a degree and a half if added to the latitude of our Australian localities ought to give a mean temperature corresponding very nearly with countries similarly situated in the Northern Hemisphere. Although these relative temperatures of the two Hemispheres may be near the truth, a comparison limited to Australia and Europe will show a divergence of the isothermal lines much greater than just stated.

TABLE

Showing the temperatures of several localities in Europe and Australia:

Latitude. Mean Annual. Winter. Spring. Summer. Autumn. Mean of warmest Month. Mean of coldest Month.

Bordeaux..... 45°-50' 56 42 56.8 70.8 56.3 72.8 41

Marseilles..... 43°-17' 59 45.5 57.6 72.5 60 74 44.4

Rome..... 41°-53' 60.4 45.8 57.8 75.2 62.8 77 42.2

Naples..... 40°-50' 62 50 — 75.5 — — —

Algiers..... 36°-48' 70 61.5 65.6 80.2 72.5 82 60

Lisbon..... 38°-40' 62 52 — 71 — — —

Funchal..... 32°-37' 68.5 64.8 65.8 72.5 72.5 75.6 64.2

Madeira..... — — — — — — — —

Sydney..... 33°-51' 61.2 52.3 56.7 68.4 67.9 71.7 49.8

Melbourne..... 38°-18' 57.7 50.8 53.2 64.3 62.5 66.6 47.8

Adelaide..... 34°-55' 63.4 53.6 56.5 72.5 71.4 79.1 52

The mean temperature of Sydney and the seasonal variations are the result of Mr. Jevous's corrected observations during three years. The means given in

Johnston's Physical Atlas, and other authorities, as 66 and even 66.6, Mr. J. ascertained were very incorrect, being founded on observations of too partial a nature. In Adelaide the observations were also far from correct, being the registered temperatures of the hours of 10h 30 a.m., and 8h 30 p.m., and gave a mean of 65, while the more extended observations of Mr. Todd show a mean of 63.3. It is probable, however, that an extension of these correct thermometric observations will give the mean of Adelaide considerably below this, the years 1857 and '58, those in which Mr. Todd's observations were taken, having been both unusually warm. The temperatures of Melbourne are taken by Mr. Jevous from the New South Wales Government Gazette, the result of nine years observations.

An examination of the table shows how much the lines of equal temperature differ from those of latitude in Australia and Europe. Europe however, is an exceptional case, since it possesses a climate, in its western portion especially, more genial and warm than any other parts of the same hemisphere under similar latitudes. The line of temperature 60 which passes through the north of Spain and Italy in a mean latitude of 42°, goes through the American continent about latitude 35°, while in the east of Asia it descends still lower. And in the same way the line of temperature 50 which passes nearly through London, Brussels, and Vienna, between latitudes 48 and 52, traverses the American and Asiatic continents between latitudes 40° and 47°. The temperature of the countries on the west of Europe is consequently higher than other portions of the same hemisphere under similar latitudes by five or six degrees. Sydney has a mean temperature about one degree lower than Lisbon, while the summer is four degrees higher, and their difference of latitude is nearly 5°. Adelaide, which is 1° further south than Sydney, has a mean of one degree above Lisbon, while the summer and winter temperatures of Adelaide are one-and-a-half degrees higher, showing a remarkable similarity in their seasonal variations as well as their mean temperatures. The mean of Melbourne is nearly two degrees above that of Bordeaux, although their difference of latitude is 5°. The seasonal variations, however, indicate a much more equable climate in the former than the latter, the difference between the winter and summer temperatures being only 13.5 in Melbourne, while in Bordeaux it is 28.8.

Possessing a climate so much resembling Portugal and Spain, it is to these countries we should look for varieties of the vine suited to the warmer localities of Australia; but it is of the vines of the Iberian Peninsula that we know less than those of the other countries of Europe. The excellent collection made by Mr. Busby, in Spain, and brought to Sydney, is now almost unknown and lost. It may be that the climate of the east coast of Australia did not suit them, and their cultivation was given up. The climate of Adelaide is so much warmer and drier than that of Sydney, especially in the autumn months, that the Spanish and Portuguese grapes ripen thoroughly in the plains and warmer situations, more so than even in Europe. Many of the best varieties have been imported recently into Adelaide from Xeres, but have not yet been tried on a large scale; sufficient, however, has been shown of their qualities to indicate their fitness for our soil and climate. To this we shall return under another head.

Besides the general temperature there are other circumstances connected with climate, affecting the thorough maturation of the grape, which are of the greatest importance, and will now come under consideration.

The thorough ripening of the vine depends not upon the average temperature of the year, but upon the heat of summer and autumn; a marked instance of this fact we have in the case of Astrachan on the Caspian, whose mean temperature is only 48°. "In no portion of the earth," says Humboldt, "neither in- the Canary Islands in Spain, or in the south of France, have I ever seen more luxuriant fruit, especially grapes, than in Astrachan. The mean summer heat of Astrachan is about 70° as at Bordeaux, while the temperature in winter sometimes sinks to 22°," that is, 54° below the freezing point of Farenheit.

There is another influence besides heat exerted by the direct rays of the sun, which ought particularly to engage our attention as vine cultivators, and which was pointed out by Humboldt so long ago as 1817, in his work De destributione geographica plantarum, when he endeavoured to attract the attention of physiologists to the difference between direct and diffused solar light and heat, and to the unmeasured heat which is actually developed in the living vegetable cell by the action of direct light. The following extract from the same author, in his "Cosmos," is interesting not only as bearing upon the subject in question, but also as foreshadowing the great discoveries which the experiments on the chemical effect of light have elicited, and which have resulted in the important art of photography. "But there is another power in heat which the unclouded rays of the sun exert on the coloured leaves of plants, and which the excellent experiments of my friends Gay Lussac, and Thenard, on the combustion of chlorine and hydrogen, have shown cannot be measured by the thermometer. And since in open and hilly situations where the air circulates freely, the temperature of the surrounding atmosphere is the same under a clear or a clouded sky; so, from the observations of the thermometer alone, without the use of the photometer, (measurer of light), we cannot ascertain the cause, why the western coast of France, on the sea coast of Britany and Normandy, although enjoying a mild climate but little sunlight, are hardly fitted for the vine."

It was at one time the currently received opinion that the vine would not ripen its fruit on the west coast of France, because of something injurious in the sea air. This is known to be an erroneous idea. The great fitness of one situation over another enjoying the same temperature, to bring the grape to perfection, is now ascertained to be owing to the greater number of sunny days during the ripening, in one than in the other. We have a striking illustration of this in the case of Cherbourg and Heidelberg, two places enjoying similar climates, so far as the general temperature is concerned:

Mean of year. Winter. Spring. Summer. Autumn.

Cherbourg, Lat. 49°-39'..... 52.1 41.5 50.8 61.7 54.3

Heidelberg, Lat. 49°-24'..... 49.5 34 50 64.3 49.7

Cherbourg, situated on the north coast of Normandy, enjoys a climate fully milder than Heidelberg, but the influence of direct solar light, sunshine, is much greater under the clear sky of the latter, than it is in the cloudy atmosphere of the sea coast, where the vine does not ripen its fruit sufficiently to make wine; while the wines of Heidelberg enjoy a reputation hardly second to any in the world. The mean annual temperature of Cherbourg is higher than that of Heidelberg by two degrees and a half, and if the summer of the latter has an equal advantage of two degrees and a half, this is counterbalanced by the autumn temperature which at Cherbourg is four-and-a-half degrees higher; yet, all these advantages in temperature will not compensate for the want of sunshine, or the influence of direct sunlight on vegetation.

If the influence of direct sunlight is so important to the perfect ripening of the grape, we may rest assured that in this respect there is no portion of Europe that can equal the Australian colonies. To the inhabitant of a gloomy and cloudy climate, the description of our clear skies "where the sun shines for six or eight months with unclouded splendour in the northern heavens," may appear very glowing and delightful in imagination; but the Australian settler, who feels the reality, would gladly see this splendour somewhat veiled, and a few more cloudy days. To the vine the direct light of the sun is food and life, and it is to the abundance of this powerful agent, that we may ascribe the superiority of Australia, as a vine growing country; for there is probably no other in which the grape ripens more thoroughly and perfectly. Although the sunlight may be sometimes excessive, it rarely injures the fruit, where proper means have been taken in the pruning and training to protect it with a covering of foliage.

Of nearly equal importance with temperature is the subject of rainfall to the Australian vine grower. In Europe the quantity of rain differs little, one year with another. In Australia, on the contrary, the annual amount of rain varies in a remarkable degree; and its fall is marked by peculiarities of a singular character.

To the reader I offer no apology for the copious extracts which follow, from the valuable and interesting article on the Climate of Australia, by Mr. Jevous, already quoted; but to the author himself, I feel that an apology is due for the liberty taken with his treatise, and the condensation and consequent mutilation to which it has been subjected.

"RAIN IN AUSTRALIA."

"Of all fortuitous phenomena of the weather, rain is the most fortuitous. On the barometer depend the winds; on the winds the warmth and moisture of the air; thence arise either clear sunny skies or moisture bearing clouds. But who shall certainly say whether in any instance clouds will precipitate rain drops, and not clear off again as unaccountably as they were produced? It is a question to which I have never seen an answer even attempted, why large black clouds may cover the sky for days and not a drop fall, while at other times, a single little cumulus may yield a passing shower.

"In comparing, too, different climates and localities, the rain-fall is the most curiously variable and eccentric of phenomena. It may range in amount from almost nothing in the rainless regions of Mexico, Peru, or Central Asia, to some three hundred inches yearly depth in Tropical India or Africa. It varies greatly from season to season, from place to place, as plains extend between them or mountains interpose; as one is more elevated, or further distant from the sea. Rain is, as it were, an accidental product of the atmospheric commotions which the Meteorologist studies; it is pretty constantly formed, but the how, the when, and the where, no one attempts to say. It is like a sediment falling from a stream of water; every little cranny of the channel, every little eddy of the stream, arrests the sediment or leaves it to be borne away.

"In the Australian climate, the rain-fall is peculiarly interesting. Many of the anomalous points of the physical geography of this continent are connected with its peculiarities."

"The following table shows the average yearly fall of rain at all those places, where it has been approximately determined. It is arranged in order of latitude :-

Mean annual Rain-fall in various parts of Australasia.

Locality. South Latitude. Mean annual Rain-fall. Years of observation. Authority.

Brisbane, Moreton Bay 27.1 35.9 23 Newspaper.

Port Macquarie 31.2 570.7 912 N. S. W. Govt. Gazette.

York, West Australia... 31.5 325.3 91 H. Ommaney, Esq.

Sydney... 33.5 149.0 019 G. E. Peacock.

Adelaide... 34.5 519.9 05 W. S. Jevous.

Lake Alexandrina— 17.45 1 G. S. Kingston, Esq.

Albany... 35.3 32.06 — Ditto.

Port Phillip... 38.1 829.1 611 Johnston's Atlas.

Circular Head, V. D. L. 40.5 035.4 54 N. S. W. Govt. Gazette,

Woolnorth, V. D. L. 40.5 043.7 54 Count Strzelecki.

Wellington, N. Z. 41.1 739.3 02 Ditto.

Launceston, V. D. L. 41.3 031.9 913 Naut. Magazine, 1843.

Hobarton... 42.5 320.3 012 W. B. Pugh, Esq., M.D.

"The greatest fall of rain, so far as we know, is upon the verge of the east coast, about Sydney (49 inches), and Port Macquarie (71 inches). The latter quantity might have been disproportionately increased by some peculiarity in the place of observation, but high flood marks in the rivers of the neighbourhood, and other facts, render its correctness not improbable. At Moreton Bay, in lat. 27°, the rain-fall is reduced to 35 inches. It would be an interesting fact if proved, that the amount of rain is greatest about 30° of latitude, and is less upon the north coast, but the information does not warrant such an assertion.

"Next after Sydney and Port Macquarie, whose rain winds come from the S.E., the most rainy localities are those exposed to the full sweep of the constant S.W. winds of the Southern Ocean, and which are also as far as possible removed from the influence of the continental area of Australia. Such are Woolnorth (44 inches), and Circular Head (35 inches), at the N.W. extremity of Tasmania. Wellington, in New Zealand, (39 inches); Albany, King George's Sound, (32 inches).

"Launceston (32 inches), and Hobarton (20 inches), have less rain on account of their somewhat inland and leeward situation.

"Port Phillip, (29 inches); York, Western Australia, (26 inches); Adelaide, (20 inches); participate in the comparatively dry continental climate.

"Having now treated of the distribution of rain over the area of Australasia, I will consider what we may term its seasonal distribution, exhibiting the usual proportions of the total amount which fall in each month or quarter of the year. The following table contains the principal information on that head, the localities being arranged in the order of the longitude:

(... таблица с месяцами и осадками, которая в PDF была частично повреждена — я опускаю её, так как она нечитаема)

"At Port Phillip and Hobarton the rain although less in quantity falls more evenly throughout the year; but the larger proportion falls in winter or spring, least in

summer. The same may be said of Wellington, although its total is larger. At Auckland, Launceston, Adelaide, and Swan River, there is a large excess of rain in the winter and spring, while the summers are but little relieved from drought. They are places essentially of winter rains.

"There is yet much to be considered before we can be said to take a correct view of the fall of rain in Australia. Not only must we know how much falls on an average in a year—a month—or a day,—but we must inquire, since rain falls only from time to time or fortuitously, how many days on an average are rainy; whether a large proportion of the total amount falls on a few of these days only, or whether it is pretty evenly distributed.

"The following table exhibits the number of days on which more or less rain fell, distinguishing each month and season at various places in these colonies:—

Frequency of Rainy Day in Australasia.

MONTH. Adelaide. Port Phillip. Boharton. Sydney. Sydney Head. Port Macquarie. New Plymouth. New Zealand. Wellington. London.

January 4 6 8 10 13 11 6 8 15

February 4 5 6 11 12 11 8 8 15

March 5 7 5 12 13 12 7 7 14

April 10 11 5 13 12 12 12 9 15

May 10 13 9 12 12 11 14 14 15

June 11 11 10 11 12 9 16 17 12

July 14 12 13 10 13 9 13 16 14

August 15 14 8 7 11 8 15 14 15

September 11 12 9 9 11 9 15 13 14

October 12 10 13 12 12 10 13 12 15

November 6 10 12 10 11 9 11 13 15

December 5 7 11 12 11 9 10 10 16

Total 105 120 109 129 143 120 140 141 175

Spring 27 34 34 31 34 28 39 38 44

Summer 13 18 25 33 36 31 24 26 41

Autumn 25 31 19 37 37 33 35 30 44

Winter 40 37 31 28 36 26 44 47 46

Another and most important feature in the rain-fall in the Australian Colonies, is the suddenness of its descent. It is evident that the same quantity of rain falling in two localities may constitute two very different climates, according to the rapidity of its fall. One, in which it comes in prolonged and gentle rain, may be a wet damp climate, while the other may be dry and parching from the quickness of descent of the rain, and the rapidity with which it runs off the surface; allowing no time for its being absorbed by the soil; and this last is the chief peculiarity of the climate of Australia. On the east coast the suddenness of the fall is often excessive, and gives rise to many disastrous floods. The following data, by Mr. Jevous, may give some idea of the quantity that occasionally falls at Sydney in a short space of time: "In 1855, during 24 hours preceding 9 a.m., of April 2nd, 8.056 inches were collected in my guage, which being however badly placed, I may state that Professor Smith measured at the Sydney University from March 29th to April 6th, 23.12 inches; and during one hour of this period fully two inches fell." "On two occasions the fall of rain at the South Head of Port Jackson, was so excessive as to deserve more particular attention. The following details are from the Sydney Government Gazette:

"1841. April 29th. Most violent storm of rain. Rain fallen on that day and night amounting to 20.12 inches. Wind, E.N.E. to S.S.E., without squalls.

"1844. October 15th-21. Furious gale and fearful deluging rains day and night of 15th. Continued heavy gale with rain up to noon of 16th.

Measurement of Rain October 15th, 1844.

P.M. Inches. Direction of Wind.

3 3.48 S.S.E. to S.

5 5.40 South to S.W. by S.

6.30 1.36 S.W. by S. to S.W.

9 1.58 S.W., — S.W. by W.

10.30 2.68 S.W., — S.W. by S.

16th, a.m., 7 5.96 S.W. by S., — S. by W.

” 20.41

To complete the character of extreme irregularity in the rain-fall of Australia, we have variations in the annual quantity of rain of an extraordinary kind. These are greater on the east coast than on the south and west, as may be seen in annexed table, but every part of the continent seems to be subject to alternate

visitations of wet years and droughts. Throughout the interior are incontestable proofs of the drying up of large lakes, and of high floods as marked by the deep water channels every where met with.

Although incomplete, the following table gives the results of observations extending over a considerable period:

Annual Variations of the Rain-fall.

YEAR. Sydney. Adelaide. Port Phillip. Port Macquarie. Hobarton.

1839 — 19.84 — — —

1840 62.26 24.00 22.57 — —

1841 76.31 18.00 30.18 52.49 14.00

1842 48.32 20.31 31.16 71.76 23.60

1843 62.78 18.00 21.54 68.39 13.43

1844 70.67 17.87 28.26 72.02 26.25

1845 62.01 18.83 23.93 44.57 16.68

1846 43.84 26.84 30.53 41.48 22.00

1847 42.79 27.61 24.00 50.05 14.46

1848 59.19 19.68 33.15 113.82 23.62

1849 21.48 25.41 44.25 47.03 33.52

1850 44.88 19.27 27.00 81.03 14.51

1851 35.13 30.63 — 92.02 18.00

1852 43.78 27.34 — 109.32 23.62

1853 46.10 26.57 — — —

1854 29.28 15.34 — — —

1855 52.85 22.87 — — —

1856 43.30 24.13 — — —

1857 50.95 22.27 — — —

1858 — 21.83 — — —

1859 — 14.85 — — —

Mean ratio of greatest to least 3.6 to 1 2 to 1 2.1 to 1 2.7 to 1 2.5 to 1

Attempts have been made to establish the term of these alternate periods of wet and drought. In Macquilloch's Dictionary, Martin's British Colonies, and other works, various periods of from seven to ten and twelve years have been assigned to them; but none of these are consistent with the registered rain-fall. Dr. Leichhardt thought that the phenomena in question were due to very long periodic variations in the climate, and that we should not ascribe anything to the advent of civilized society, which is a disturbing influence of recent date. Mr. Jevous expresses a similar opinion: "The impression which I have received in examining this question is, that there is really some historical foundation for the hypothesis of long dry and wet variations of climate. Independently of those instances of dry lakes and creeks, which afford indisputable but indefinite evidence of something of the sort, I think that one or two climatic periods have occurred since the foundation of this colony (N. S. W.). Dr. Leichhardt's surmise therefore appears a happy one."

Regarding the opinion that the climate of these colonies has been greatly changed by the influence of man, the same writer makes the following remarks: "Climate indeed is a subject upon which the most extravagant and unreasonable statements are made. Not only do many men, even of much scientific information, imagine that within the short scope of their own recollection they can detect a permanent change in weather or some other phenomenon, which would involve a connected change over all the regions of the earth, but they even assert that man's muscular strength and mental ingenuity can effect such changes. The clearing away of trees, they say, will make a climate dry; extensive reservoirs of water may increase the moisture of the atmosphere. But they forget that a climate depends entirely on winds which have a world-wide extension, and which bear moisture from pole to pole; it is probably very seldom that water falls as rain within a thousand miles of the spot where it rose upwards as vapour; to influence therefore the climate of one place man must exert an influence over wide regions. Now of the whole surface of the earth three-quarters are occupied by the untamed ocean, and of the dry land probably not more than one-fourth is at all inhabited by man. Again, even in the most populous countries of Europe, such as England or Belgium, only the lesser part of the land is cultivated or much changed by man. How utterly inappreciable then must be man's influence over the unmeasured tracts of Central Europe, of Asia, Africa, and America, and lastly Australia; tracts which he merely calls his own? In several instances indeed philosophers have succeeded in proving that the climate, or at least the temperature of the air in France and Italy has not permanently varied in the least degree for thousands of years."

From an examination of the preceding tables we may draw the following conclusions: That on the south east coast of Australia the peculiarities of the climate with regard to irregularity of the rain-fall are most marked; there we find not only the largest annual fall amounting to a mean of 49 inches, but also the greatest variation in the annual amount; the maximum and minimum of Sydney being 76.3 and 21.5, or in the proportion of 3.6 to 1. The rapidity of the rain-fall also greatly exceeds that of the other settled portions to the south and west of the continent, and amounts in many cases to the most destructive floods. These

floods occur chiefly in the autumn months during the prevalence of a monsoon-like wind blowing in at that season upon the S.E. coast. The rains of New South Wales are principally summer and autumn rains, while those of the west coast of Australia are winter rains brought by the great westerly wind of the Southern Hemisphere, which prevails in winter. The westerly wind, being also the rain-bearing wind of Adelaide, produces winter rain, an immense advantage to a country whose rain-fall is small. The difference in the humidity of one year compared with another depends not alone on the annual fall, but also on the period of the year when it takes place. Rains falling in summer and autumn when the ground is hot, quickly evaporate, while the same amount of rain falling in winter and spring is absorbed and retained. The rain-fall of the southern coast although sudden, is by no means so much so as that of the east coast, consequently less of it goes to waste by running off the surface.

The peculiarities of the rain-fall of the different parts of the continent, Mr. Jevous observes, "fall into beautiful harmony on the simple supposition of two antagonistic winds:

1st. The great westerly wind of the Southern Hemisphere.

2nd. A monsoon-like wind on the S E. coast.

The first brings a limited supply of rain every winter to those coasts exposed to it (Western and South Australia), but affords little to Victoria and less to New South Wales. The second, or easterly wind, brings abundance of rain to New South Wales, and a moderate quantity to Victoria. If, under these circumstances, the monsoon wind were to fail, or be partially overpowered by the westerly winds, New South Wales would be deprived of all rain; Victoria would be partially affected in the same manner; but Western Australia would be, if anything, oppositely affected. In short, drought would be felt wherever the easterly winds generally bring rain, and in proportion as this supply is derived. Such, I think, is the most general statement possible at present of the cause of the so called periodical droughts, and of the extraordinary rain-fall of New South Wales. Or, we may say perhaps, that the S.E. extremity of Australia is only more fertile and habitable than other parts, because its climate is assuaged by a monsoon wind. In the absence of this, sterility and thirst would be its fate.

"It is almost useless to touch upon the ultimate causes of such changes. The rain-bearing winds of New South Wales may be connected with the S.E. trades, which, according to the common rule, commence a little north of Moreton Bay, but move up and down with the sun. Now if these winds at any time extend themselves unusually far south a wet season might be produced along the S.E. coast. This theory finds support, I believe, from the Rev. W. B. Clarke, who has watched and investigated the climate many years. Just the same effect would be

produced if any cause acted from the centre of Australia to hinder the advent of the sea winds, and project the fiery breath of the sun-heated plains upon the unexpecting coast lands, as during hot winds. I explained before how a dry current of air (the returning trade wind), was supposed to descend into the centre of Australia. This current causes the hot winds of the coast, and its unusual force or steady continuance might cause the droughts of New South Wales, even although it were not actually felt there. But these are mere speculations; to reason accurately upon such wide acting causes will not be within any persons power till meteorology is quite another thing."

Notwithstanding the strange peculiarities and vicissitudes of climate of the Australian colonies, the vine seems to adapt itself to every variety of soil and situation, and bids fair to become in a very short time as much acclimated in this continent as in Europe. The excessive droughts which are the bane of the Australian colonies, are borne by the vine with great hardship. The hot wind, our sirocco, may blow its furnace breath for twelve or even twenty-four hours, leaving the country a dreary brown waste. The dingy foliage of the trees and shrubs, and the brown hue which New Holland assumes as her summer garb, become more sombre and sad after the severe ordeal. Amidst this desolation, the vine retains its verdure, to cheer the eye and heart of man, an everlasting emblem of hope and endurance to stimulate and reward his exertions. The Eucalyptus and Mimosa frequently succumb under the desolating influence of a succession of dry years, and many die in the long droughts; but the vine lives and bears its fruit, unscathed by the general blight; and while the native monarchs of the forest, the aborigines of the ground, perish, this little exotic plants its roots in the soil and bravely holds its ground; a fit type of the European settlement in the Great South Land.

CHAPTER III.

SOIL AND SITUATION.

In the choice of situation for vineyard, one of the most important considerations must be the soil. If the best authorities in the old world are consulted on the subject of soil best fitted for vine growing, it will be found that good wine is produced on nearly every variety of ground, and the debris of every geological formation. The only exception to this is an impervious cold clay, which is condemned by all writers on the subject, both ancient and modern, as unfavourable to the vine. The unfitness of such soils for vineyards is to be ascribed not to anything injurious in argillaceous or clay soil in itself, but simply to the mechanical obstruction it causes to the free passage of moisture and air. There are many of the most celebrated vineyards in the world whose soil consists in great part of clay, but there it is mixed with other matters which tend to keep it free and open.

So far as our experience goes in Australia, a considerable portion of argillaceous ingredient in the soil is highly favourable to the vine, serving to retain the moisture which in a very free soil is apt to evaporate too quickly. It is in the subsoil, however, that the presence of clay is most beneficial, especially when mixed with calcareous and gravelly matter. A soil in which a marl of this nature underlies a free loam, is well adapted to these dry climates, and has produced wine of good quality with an abundant crop.

The importance of a subsoil retentive of moisture in the dry parching climates of Australia, has been forced upon us by experience, and there is none which has been found more favourable to the vine than marl. Marl consists of a mixture of clay, lime, and sand or silica, in various proportions, and it is called clayey, calcareous, or siliceous marl, according to the preponderance of one of the ingredients over the others.

The presence of lime in the soil has generally been regarded as of the greatest importance to the vineyard, and many have looked upon its presence as essential to the growing of a first class wine; but this is not borne out by fact. Although three-fourths of the vines in France grow on calcareous soils, there are many excellent vineyards in whose soil little or no lime can be detected. Many celebrated vineyards in Burgundy, and amongst them the Hermitage, are said to consist of decomposed granite; and many of the best wines of the south of France, Italy, Sicily, and Madeira, are grown on a purely volcanic soil.

In Mr. Busby's journal we find the following observations which are at variance with the received opinion of the non-existence of lime in the famous hill of the Hermitage: "M. Machon, the gentleman whose property we were traversing, pointed out to me the direction in which a belt of calcareous soil crossed the ordinary granitic soil of the mountain, and he said that it requires the grapes of these different soils to be mixed in order to produce the finest quality of Hermitage I took home a portion of the soil which he pointed out as calcareous, and the degree of effervescence which took place on my pouring vinegar upon it, indicated the presence of a considerable portion of lime."

The following observations by the same writer, on the importance of lime as an ingredient in the soil of vineyards, are also worthy of notice: "I cannot refrain from observing, that from the albarizas of Xeres, the most southern vineyards of any reputation in Europe, to those of the chalky hills of Champagne,—amongst the most northern,—I met with no vineyard of any reputation in Europe which was not more or less calcareous. Although it is acknowledged that two-thirds of the vineyards of France are situated upon soil more or less calcareous, by Chaptal, and other writers upon the subject; they have stated, that provided the soil is porous, free, and light, its component parts are of little consequence; and they enumerate granitic, schistose, argillaceous, flinty, sandy, and calcareous

soils, as equally well qualified to produce, and as actually producing in different parts of France, wines of the finest quality. It appears evident to me, however, that these writers have in many instances been misled by the representations which have been transmitted to them: as for instance, when Chaptal and Cavoleau cite the wine of Hermitage as an instance of the excellence of wines produced upon the debris of granite; while the fact is, that the wine of the hill of the Hermitage owes its superiority over the wines of the other hills in its neighbourhood, only to the circumstance of the granitic soil of a part of that hill being mixed with calcareous matter; and but for this circumstance, I am satisfied that the wine of Hermitage would never have been heard of beyond the neighbourhood where it grows. I am therefore of opinion, that the finest dry wines owe their superiority chiefly to the quality of the soil; and I am much mistaken if it be not found that the soils of all vineyards producing dry wines of superior excellence, are strongly calcareous. All my observations have led me to this conclusion, and I know of no instance to the contrary. It will be observed that I here only speak of dry wines; for sweet wines of great excellence are produced in a variety of soils, and, in fact owe their qualities more to the variety of the grape, and the manner in which it is treated, than to the soil. The sweet Muscat and old Mountain wines of Malaga are celebrated all over the world; but though they have the same varieties of vines at Malaga as at Xeres de la Frontera, and pursue a similar practice in making the wine, the best of their dry wines, produced on a soil consisting of decomposed slaty schist, are insipid and flavourless, when compared with the Sherries which are produced on the chalky hills of Xeres. The sweet wine of Rivesaltes—the most celebrated in France—is grown on a granitic soil covered with pebbles; and the sweet wines of Casperon and Collioure, in the same department, are produced on hills of schist, as nearly as possible resembling those of Malaga. But though the dry wines of both these soils are well known, they are not distinguished for their fineness or flavour. Their excellencies are their strength and rich colour, which make them valuable for mixing with the weak and light-coloured wines of the ordinary growths of Burgundy and Macon, which supply the chief consumption of Paris."

The above remarks are particularly entitled to our consideration as being the result of observations made during a tour in Spain and France by an Australian settler, whose object was the collecting information which might in any way bear upon the subject of vine growing in his adopted country. And we shall follow up Mr. Busby's remarks with a quotation from a recent French work, (Travail des vins, &c., per M. Maumené), on the effect of soil upon the quality of wine: "Here we have the results, by M. Clary, from the wines of Cahors, showing the quantity of alcohol in those of limey soils on the one hand, and in clay soils on the other, both red and white wines:

YEARS. RED WINES. WHITE WINES.

Calcarious Soil. Argillacious Soil. Calcarious Soil. Argillaceous Soil.

1822 11.3 9.6 12.3 11.0

1842 11.0 9.0 11.0 10.0

"Let us note the proof of the influence of soil on the quality of the wine, or, in other words, its alcoholic richness. The results of M. Clary show clearly the difference obtained in the culture of the same grapes on calcarious and on argillaceous soils. The alcohol is always more abundant in the former, or, what is the same thing, the grape ripens better there."

Lime then may be regarded as the most favourable of all minerals to the healthy growth of the vine, producing a wine of a generous and enduring character, in the climates of Europe. But although this is the effect of a limey soil in the more moist climates of the Northern Hemisphere, it may be objectionable in very dry climates, especially when in excess. It is found that in such soils, the vines, stimulated to vigorous growth, soon exhaust all the moisture within reach of their roots, and, if means be not taken to furnish a fresh supply to the soil, over and above the ordinary rain-fall on the surface, the vines soon begin to suffer.

Where a sufficient supply of moisture can be obtained, as by running in upon the vineyard the water from higher ground, or by irrigation and thoroughly soaking the subsoil, the calcareous soils are the best perhaps in these colonies. Where no such extraneous supply can be procured, and the vine must depend entirely upon the rain which falls upon its own area, those soils in which lime predominates are not to be recommended for vineyards in the drier parts of Australia, where the rainfall only averages 20 inches, and is often for two or three years in succession considerably below this.

By the term calcareous soil is to be understood, one in which lime, or rather carbonate of lime, in a disintegrated state, forms a large portion of the soil. The other ingredient of the soil with which the lime is mixed may be a light sand, so light as to be utterly unfit for vines in these colonies; or, it may be clayey and so stiff when wet as to be useless. More frequently it is mixed with a rich loam, a happy combination of clay, sand, and ochre, in which the lime is generally in the state of small gravel under a thin crust of friable limestone; and this will generally be found the most advantageous for vine culture where sufficient moisture can be commanded.

Notwithstanding the great array of opinions in favour of calcareous soil for the growth of wine, there are wines of first quality produced on soils in which lime does not exist, and in the hot summer climates of Australia we know that the vine ripens with much greater certainty than in European climates, and may therefore be cultivated with advantage on soils which would be unfit for it in the Northern Hemisphere. There are situations where a light loam of ten or twelve inches on a subsoil of cold wet blue clay has been experimented on, and by a system of drainage, has been rendered not only fit for vine culture but produces wine of excellent quality. This is given as an instance of what may be done with the most unpromising ground in a fine dry climate, and not as an example to be

followed in the selection of soil. In fact, any free soil, permeable, and at the same time sufficiently retentive of moisture, will grow the vine, no matter what the composition of the soil. It has long been the general opinion that the most fertile soils are unfit for the vine, but this is a mistake. In the rough notes by Sir William Macarthur, we have the following, bearing on this subject: "The mere fertility of the soil will probably not render it the less fit for the production of finer wines, provided there be free drainage; and that other conditions, such as climate, site, and aspect, favour the complete maturation of the crop. Free drainage, in other words complete permeability for all superfluous moisture, to a great depth, combined with a certain degree of consistence, are perhaps the most important conditions to guide one here in selecting a soil for a vineyard. If to a certain extent mingled with round stones or pebbles, or fragments of soft decomposing rock, so much the better." With regard to an opinion entertained, that roots of vines do not strike deep: "This is surely a mistake. I know from personal observation, that under circumstances which favour them, they will penetrate to a great depth. In Europe I once saw a huge mass of soft tufaceous rock, a portion of a vineyard, which had detached itself after heavy rain, and slid down hill. Though more than twelve feet thick, it was completely traversed by numerous roots of the vines. Here, in sinking a well, during a very dry season, in deep alluvial soil, in the vicinity of vines eight years old, we found the roots nearly sixteen feet deep; and I see no reason to doubt their being much deeper now, because the soil is perfectly well drained to double that depth. It may be observed that in such a soil a wet or dry season makes little difference in the vigour of the vines, but that the dry season produces much the best wine." Regarding the soils of Burgundy and Medoc, we have from the same: "The best wines of Burgundy are grown upon a strong calcareous loam, good wheat land, which cracks into seams when very dry, resting upon deep beds of porous limestone." The wines of Medoc (Claretas), are produced upon a loose dark coloured silicious sandy soil full of quartzose rounded pebbles eighteen inches or two feet deep. In many of the best vineyards underneath is a very fine stratum of hard conglomerate, (pebbles similar to the other cemented together by iron). This is now always broken up in replanting. Formerly they contented themselves with breaking through, with an iron bar, separate holes for each vine. Under some vineyards the loose silicious soil prevails to a considerable depth; but under others, and those producing some of the finest wines, I observed strong yellowish clay, but nowhere calcareous earth or stones"

In Europe the greater part of the vineyards are planted on ground unfit for the growth of any other crop. It is not that the rich fertile lands devoted to wheat and ordinary agriculture are unsuited to the vine, but such ground is thought to be better employed in producing food, while the accommodating vine is content with any situation in which its roots can penetrate into the crevices of the rocky soil, and where it has the free breath of heaven to fan its leaves, and the direct rays of the sun to ripen its fruit. The sunny slopes of the hills of France, of a poor dry soil, are the most frequent sites of vineyards; and hence has arisen the mistake that it is only on poor dry soils that wine of good quality can be grown. This is correct so far only as the cold wine countries are concerned. In the north of France and along the northern limit of the wine districts of Europe, the vine requires a dry soil to ripen its fruit sufficiently to make wine; but in warm

climates as Spain, Portugal, and Italy, there is heat sufficient to ripen the fruit of the luxuriant vines which grow on the rich soils of these countries. The more saccharine fruit of the warmer climates, is not so much affected by soil as the delicate produce of the diminutive vines of colder regions.

Even in the warmer districts of France, the best vineyards are in some cases not situated upon the sides of hills, but at their base. On this subject Sir W. Macarthur says: "Slopes with good aspects are almost always to be preferred to flat surfaces; yet the sites of most of the Medoc vineyards are only sufficiently undulating to say they are not quite level. Many of the most renowned of the Burgundy vineyards are upon the gentle slopes at the base or talus of the celebrated Côte d'Or. I visited those of Clos Vaugeot, Romaneé Conti, Romaneé St. Vivant, Richebourg, La Tache St. George, &c., producing the finest wines. Their inclination seemed to vary from about one in twelve to one in twenty-five or thirty. I was assured that the vineyards higher upon slopes more steep and stoney, produce wine inferior in quality, gradually becoming less valuable as you ascend, until the higher vineyards yield only common wine. The range itself, covered with large masses of free limestone rock, extends much higher than the uppermost vineyards. The plain at the base which is almost conterminous with the first class vineyards, and seems to be composed of the same soil, produces only common wine. Here many of the proprietors prefer to cultivate the "Zamay," on account of the greatly increased produce; but even when cultivated with the "Franc Pineau," (the finest grape), they obtain only a bitter kind of "vin ordinaire." In the Medoc I saw vineyards producing only "vin de paysan," conterminous, sometimes absolutely inclosed amongst those which gave the best wines; yet there was no apparent difference in soil, aspect, or in the variety of the vine. Last year's crop of the Chateau Lafitte vineyard was sold recently for £34,000! The extent of the vineyard being I think 130 acres. Four hhds to the acre is reckoned a large crop. Adjoining the Chateau Lafitte estate are vineyards differing little if at all from it in aspect and soil, the produce of which is not so valuable by ten-fold."

Whether we shall ever arrive at anything so exquisitely delicate as Chateau Lafitte, or Romaneé Conti, time will show. At present we may rest assured that the range of soils fitted for the vine in Australia is quite as extensive as in Europe. Experience has shown that the vine in our drier climate requires a soil considerably more retentive of moisture than it does in Europe, to counteract the excessive evaporation which takes place in our dry summers. From ignorance of the great difference between the climates of the Northern and Southern Hemispheres, many vineyards planted according to the general practice of France and Germany, on the sunny slopes of calcareous hills, have proved failures; while many low damp situations where there is a subsoil permeated by water from higher ground, and which would be considered altogether unfit for the vine in Europe, have proved excellent vineyard sites in Australia.

In selecting sites for vineyards in these colonies, the most important preliminary to be considered is, the supply of moisture to the roots of the plant. The exceedingly variableness of the rain fall to which all the Australian colonies are subject, calls for means of water supply from artificial sources during those years or succession of years in which the average of rain is lowest. From the tables already given it will be seen that Adelaide suffers this evil in greater degree than either New South Wales or Victoria. There are few localities, however, in any of these colonies in which it would not be of advantage to husband carefully all the rain which falls during the drier years.

The desiccating effect of the vine upon the soil in these colonies, is a subject of the greatest importance to the Australian vine grower, and it is one to which attention has not hitherto been sufficiently directed. During the scorching months of summer the evaporation from the surface of the ground is excessive, but where the grass is withered, or cultivated land is in stubble or fallow, the evaporation is limited. At first the surface parts with its moisture, but the layer of dry earth which forms eventually protects the underlying soil and enables it to retain a portion of its moisture. Very different is it with ground in which the greedy vine grows, the vine goes on during the whole summer extracting from it every particle of moisture to the furthest depth to which its roots can reach. Here the soil becomes dried to an excessive degree, and where there is a deficiency in the annual rain-fall, the vine, hardy and enduring as it is, begins to suffer, and becomes stunted in its growth. But it is not the vine alone that thus robs the soil of the prime element of its fertility. There are gardens innumerable in Australia which, after two or three years of most luxuriant crops of vegetables and fruit, have become barren, in consequence of the exhaustion of their moisture; on digging down two or three feet the soil presented the appearance of extreme desiccation, which will require more than an average fall of rain to restore fertility. In such cases it is necessary to obtain an extraneous supply of water to bring back the ground to its original productiveness.

The evaporation or exhaustion which is constantly going on from the leaves of all plants, is very great. "The quantity of fluid exhaled varies in amount in different plants. A sunflower, three feet high, gives off twenty ounces of watery fluid daily. Hailes found that a cabbage, with a surface of 2,736 square inches, transferred at an average, nineteen ounces; a vine, of 1,820 square inches, from five to six ounces."* If such is the amount of exhalation from plants in the climates of Europe, how shall we estimate the quantity given off each day by a vigorous vine in our parching Australian summers. A vine of ordinary size in a favourable position, will expose a leaf surface of 20,000 square inches, and if we allow the exhalation to be four times as great as in Europe, we have 200 ounces per day, or 280 gallons in eight months or thirty-three weeks, during which the vine is in full foliage. This quantity of moisture is nearly the amount which falls in an average year on the superficies assigned to a vine of three square yards, of which a part more or less must be lost by ordinary evaporation and running off the surface. At this rate it is easy to see what the issue must be in a short time, if

the only source of supply of moisture is from the rain which falls on the surface. By deep trenching we may prolong the existence of the plant for a few years by extending the source from which the moisture is derived; but the result must be the same continually.

From the nature of our rains which fall quickly and heavily, the greater part of the water is utterly lost. An inch or more of rain falling in a few hours has no time to sink into the soil. It forms small rills which uniting, become water-courses, hollowing out deep channels through which the water pours into the gullies. These again swell into torrents which carry before them all obstacles to their progress. In this way our rain-fall, so small and precious, is almost lost. Much has been said about irrigation and the incalculable benefit it would be to us in increasing the fertility of our fields and gardens. Irrigation, which generally means the supplying the ground with water, conducted from rivers or watercourses, or raised from wells, cannot be carried out except in a few favoured spots, where a supply of good fresh water is at command; and even then, it is attended with great expense, involving a large outlay at first, besides the current expenses of working the machinery. In the few cases where it can be carried out, without very great expense, there can be no doubt of its ultimate advantage; we have instances of its success in countries less requiring it than ours,—Lombardy for example,—and it cannot be doubted that here the same results would attend its application to our more arid climate. "Give us moisture," says the Adelaide farmer, "and we shall grow anything and everything."

But before we resort to the expensive works and machinery required for irrigation of this kind, it would certainly be advisable to take advantage of all the rain that falls and prevent the greater part from running to waste as it now does.

By means of trenches cut across our fields much of the rain which now runs off in water courses, might be retained to soak into the ground. These trenches must of course be made perfectly level, otherwise they will become water-courses, and do more harm than good. Further to facilitate the retention of the water, it would be advisable in all cases to plough the ground invariably along the face of a slope, so that the furrows may impede the running off of water.

This, which is so necessary in ordinary agricultural operations, becomes of infinite importance in gardens and vineyards, where the exhaustion of the moisture by the rank vegetation of summer is excessive. There the ordinary rain-fall on the surface is quite inadequate to restore the moisture of which it has been deprived; it is therefore necessary to obtain some extraneous supply, and this can be got most readily by conducting into the garden or vineyard, any stray streamlets in its neighbourhood which would otherwise go to waste. Water-courses, on an adjoining road, or rills, which run off on a neighbouring paddock, if conducted into the garden to trenches dug in the dry exhausted beds will soon restore their fertility. The effect of inundating ground thus desiccated, is quite surprising. Rich fertile gardens, which, from exhaustion of their moisture, have

become utterly sterile, and in which manures of all sorts had been tried in the vain hope of renewing their fertility, have, by this process, been at once restored to their former productiveness.

The same effect has followed the introduction of waste water into the vineyard, and although the quantity of water was small in comparison with that supplied to the smaller area of the garden, the results which ensued in the increased growth of the vines, and improvement in the fruit both in quantity and quality, were such as to recommend the adoption of the system and carrying it out on a larger scale. There are few spots in the drier portions of Australia in which a supply of water, over and above that which falls on the surface, would not be highly advantageous to the vine. In an open porous soil, a rain-fall of twenty inches, supposing it were all absorbed, is but a poor supply for the vine, to last during the long dry summer; and when the fall does not exceed twelve or fourteen, it is altogether inadequate to sustain it in vigour. It happens that some of the best vineyards in these colonies, become unproductive after a few years, from the inadequacy of the rain fall to restore the excessive loss of moisture carried off by the vigorous vegetation. The limestone hills and slopes about Adelaide afford a soil, site, and climate, admirably adapted to vine growing, but many of the vineyards, on such sites, have become unproductive, or at all events have fallen off in their produce, from this cause. By a little care and trouble in laying out the vineyard, this great evil, the desiccation of the ground, might, in most cases, have been obviated. The site of the vineyard ought to be well down on the slope, so that it may have the advantage of the drainage from the portion of ground above it. From this higher ground, small surface drains may be cut to conduct the water into the vineyard, where trenches are prepared to receive it, and allow time for its being absorbed. As only part of the rain would thus find its way to the vines, it might be necessary to devote two or three acres of such receiving ground to each acre of vineyard. No doubt such ground would thus be rendered unfit for anything but pasture; but there are often bare rocky spots on the top or brow of the gentle elevations of our limestone hills, at present utterly useless, which might be thus turned to good account in increasing the fertility of neighbouring ground.

From the suddenness of the fall of rain it is obvious that there would be considerable risk incurred, by thus introducing an unusual run of water into the loose ground of a vineyard. During a heavy fall the trenches would rapidly fill, and overflowing, would establish water-courses down the slope, carrying away part of the best soil of the vineyard, and doing serious mischief. It would be necessary then, where such a system of watering is adopted, to provide means of letting off quietly from the trenches the superabundant water. A channel formed of stones or wood and leading away just below the level of the bank of the trench, at either end, would conduct the overflowing water past the danger of injuring the vineyard; but during the summer months there occur occasionally thunder showers which might be turned to advantage in our gardens and vineyards were there drains made to conduct the water where it is wanted. The effect of rains in December and January, between the flowering of the vine and the ripening of the fruit, is most beneficial to the crop both as to quality and

quantity. This applies of course only to the drier parts of Australia. On the east coast of the continent, the summer rains fall so heavily that there is generally an excess of moisture. Besides the ordinary climatic phenomena of temperature and rain-fall, there are other meteorological influences which exert a prejudicial effect on the vine, and which must be attended to in the choice of vineyard sites; of these, late frost is probably the most serious. The injury done in some cases by frost has been so great as to cause the total loss of the crop, and this has happened even in a succession of years. October is the month in which this scourge is most destructive; but frosts have occurred even in November, destroying in one night the hope of a crop for that year.

The localities most liable to frost are unfortunately those otherwise best suited for the growth of the vine in our dry climate. The low alluvial flats, which retain their moisture during the dry season, and are generally well moistened by overflowing water from the surrounding higher ground, and afford some of the finest vineyard sites we possess, are most obnoxious to this destructive visitation. In a clear star-light night, the radiation of heat from the earth is very great, more particularly in our very clear atmosphere; and where the air is stagnant, as in valleys and hollow places, that which is in contact with the ground gets cooled down rapidly, and, being thus rendered heavier, has no tendency to rise; it thus goes on cooling until it nearly reaches the freezing point. The plants also cool down even below the surrounding air and get frozen.

This effect of radiation in cooling down the surface, and the air in contact with it, must have been observed by every one who has travelled in a clear still night in an undulating country. In the hollows and valleys the air is cold, chilly, and damp, but the traveller no sooner begins to ascend than he finds the temperature rise, and when he has reached a moderate elevation, sixty or eighty feet, he finds a slight current of air which feels warm and genial. As he proceeds, his descent is marked by a gradual fall of temperature, until he is again immersed in the cold stagnant air of the low ground. There are some situations more liable to these visitations than others. Within a moderate distance of the sea, there is almost an immunity from frosts, while the further we proceed inland the greater the risks from this evil.

Situations liable to spring frosts ought to be avoided for vineyards, and not on this account alone; the same peculiarity in situation which produces the frosts of spring and early summer also causes a similar lowering of the temperature at other seasons. During the summer and autumn, the air in the hollows cools down considerably below that of the surrounding country, during clear nights, and this to a degree which must be very prejudicial to the ripening of the fruit. At this season it is desirable that the temperature throughout the twenty-four hours should be as uniform as possible. These hollows are also objectionable from the concentration of heat under the scorching rays of the mid-day sun; for, although the accumulation of heat is so far alleviated by the rising of the heated air, and its consequent renewal by cooler currents drawn in from all sides; such places are, nevertheless, invariably better than the surrounding hills and slopes, and

the grapes are more apt to be scorched by the fierce rays of the nonotide blaze, in these hollows, than in more airy situations. In excessively hot seasons the vines have been utterly scorched, the fruit entirely lost in a few hours, and even the leaves nearly all withered.

Both New South Wales and Adelaide furnish abundant proofs of the error committed in the choice of low flats for vine growing. There are in both colonies vineyards which, for a succession of years, have had their crops destroyed by late frosts; and the losses have been so disheartening in some cases, as to lead to the thought of abandoning these, and planting the less productive, but safer hill sides.

The only way of saving a vineyard from the effects of frost is that pursued in Europe, and given in detail in the following extract from Maro's letters: "There is a very simple preventive, which every person possessing a vineyard in a situation exposed to spring frosts, should be prepared to adopt. Twice this season (on the 4th and 19th October), has a vineyard which is under my observation, been preserved from extensive damage by the precaution. Small heaps of straw, rather damp, and mingled with a few shovelsful of loose earth are placed in readiness at intervals of six or eight yards, all round the vineyard, and as it is of some extent, along some intersecting cartways. A dray load of this short straw may, perhaps, be divided into twenty or thirty heaps. If the thermometer and the appearance of the weather over night indicate the possibility of frost, a vigilant look out is commenced an hour or two after midnight. As soon as the thermometer approaches the freezing point, or falls a little below it, a certain number of the heaps of straw, say every sixth or eighth, is lighted; each is so managed as to be kept smouldering (which is very easy to effect by the admixture of earth, or by sprinkling a little water over it), for about an hour. Of course a dense smoke is produced, the state of the atmosphere preventing it from rising or dispersing. As they burn out, fresh heaps are lighted, taking care to reserve a sufficient number to produce the densest smoke from sun-rise to an hour after. By these simple means, either the dew is prevented from freezing upon the tender shoots of the vine, or if they are frozen, the sun's rays are prevented from acting upon them until the slowly increasing warmth of the atmosphere has thawed them. At the vineyard above mentioned, on the morning of the 19th October, the thermometer fell below the freezing point soon after midnight, and was at 28° or 29° before sunrise; no damage was done to the vines, although potatoes, not more than two hundred yards distant, were quite cut off."

High winds are very injurious to the vineyard, more especially in spring, when the young shoots are tender and easily blown out of their sockets; leaving a deep wound from which the sap continues to run for days, to the exhaustion of the plant. During the flowering also high winds are apt to prevent the foundation of the flower, and thus render the blossoms abortive. Some kinds suffer more than others from this evil. The Muscat, Muscatels, and some of the fine table grapes, are frequently so injured during flowering that a full perfect branch sometimes

cannot be obtained, and many present a stalk with only half-a-dozen berries. The injury done by high winds, might, in many cases, be obviated by raising a shelter of forest trees to windward of the vineyard; and for this purpose nothing can be better than the native trees, such as the gum or Eucalyptus, which grow vigorously and rapidly. A belt of such trees planted to the west or south of a vineyard at the time of its being formed, will begin to afford shelter by the time the vines come into bearing. Care must be taken that the roots of the trees do not reach the vines; and fifty yards is the nearest distance at which it would be safe to plant them.

Hail storms are perhaps the most destructive of all the meteoric visitations to which the vine is subject. An ordinary shower of hail during the summer sometimes does extensive damage; every hailstone leaves its mark on the leaves and fruit, and when a berry is touched it shrivels and decays. Heavy hail storms sometimes devastate a whole district, and destroy every green thing in their course. The vineyard, after such a visitation, presents a most melancholy aspect; the leaves and fruit stripped from the plant, lie strewn in heaps on the ground, while nothing is seen above but the stem and the remains of a few naked shoots. Such severe storms are fortunately rare, and are limited to the vicinity of the mountains on the east coast. This is a scourge which is also severely felt in Europe.

The hot wind is another of the injurious climatic influences of Australia. When the thermometer in the darkest and coldest room, is 100°, and under the shade of a verandah it rises to 115°, what are we to compute the temperature to which objects animate and inanimate are subjected under the direct rays of the sun? With dead matter this will vary according to the nature of the material exposed, its power of absorbing and conducting heat, and so on; but in organic living matters, animals, and plants, there resides a power of resisting heat, as well as cold, to which the functions of respiration and perspiration are subservient. That this power is possessed by the vine in an eminent degree, is known to all who have cultivated the plant in these colonies, and observed how little its foliage is affected by a hot wind. But great as is its power of endurance it is not wise to expose the vine to any unnecessary degree of heat, and this leads us to the subject of aspect for vineyards.

From the nature of our climate in the warmer portions of these colonies, there can be no want of direct light to ripen the grape; in fact, in many situations there is an excess of this agent, and instead of selecting an aspect inclined to the meridian, as is done in France and Germany, to obtain the maximum of heat and light; it is better in most cases to avoid this, and choose an eastern slope, or a level surface, provided it is not exposed to spring frosts. The power of the sun's rays depends upon the angle at which they strike the surface. When the rays fall perpendicularly on the ground we have the maximum of heat, and as they are inclined, their power diminishes. The mid-day sun in summer is only eleven degrees from being over head in the latitudes of Sydney and Adelaide, and a slope facing the north, with a rise of one foot in six, would have the sun's rays

falling perpendicularly upon it at noon; and for an hour before and after noon, the inclination of the rays would be less than upon level ground, and the temperature consequently higher. Such an aspect then is most objectionable where the heat of the sun upon the plain is already too hot during the middle of summer.

In colder situations, either from latitude or elevation, where it requires the full heat of the sun to ripen the fruit, a northern aspect is desirable. On the south coast of Victoria, where the climate is comparatively cool and damp, a slope to the north, or better, to the north-east, is to be preferred. In the Barabool Hills this aspect has generally been chosen and found the best. The cold stormy winds which blow in at all seasons of the year from the south-west can be best counteracted by a slope in the opposite direction. The shelter from belts of trees is nowhere more called for than on this south coast of Victoria, where the hot winds are so suddenly followed by cold blasts from the sea, known by the appellation of southerly bursters.

An eastern aspect is considered desirable in every part of the world. The rays of the morning sun are particularly genial to the vine; and in the warm regions of Australia it is to be commended as being less under the influence of the scorching rays of the sun. The hottest period of the day is two hours after noon; at this time the rays of the sun fall more obliquely upon an eastern slope than upon a plain, and consequently exert less power upon it.

CHAPTER IV.

PREPARATION OF SOIL.

In colonies where wages are high and likely to continue so, the chief object of consideration, in commencing any work such as vine growing, will always be the economising of labour, in the first operations, and arranging our plans so that the after or permanent work may be carried on efficiently, with as little manual labour as possible. True economy, however, forbids any niggardliness in the first expenditure, which would lead to slurring over the work. Let every thing be efficiently done with all due regard to the saving of labour. To this end, we must choose a soil and situation naturally fitted for the vine, or so circumstanced as to require a small amount of labour to render it so. The vine requires a considerable depth of open soil to allow its roots to penetrate two-and-a-half or three feet below the surface, and while the soil to this depth ought to be free and permeable to the rain, the subsoil should be somewhat retentive of moisture. This last point is one of great importance in these colonies, and has been already

discussed under the head of soil. We there endeavoured to show the advantage of having the privilege of an extra supply of moisture to the vineyard, by means of surface drains from an adjoining paddock or piece of waste ground, a little elevated above the vineyard.

There are many situations in these colonies where the ground requires no preparation by the hand of man, further than a deep ploughing, harrowing, and rolling, or a simple digging with the spade, to fit it for planting the vine. There are others fitted for vineyard, which require the preliminary operation of hand-trenching to a depth of two or three feet. The expense of this hand-trenching, at even an ordinary rate of wages, is so great, as to deter many from attempting to enter upon a work, which involves so large an expenditure of capital, and from which there can be no return for several years. Where the soil and situation are favourable, however, the ultimate prospects are such, as to warrant even an outlay of £50 or £60 per acre, on the mere preparation of the ground by hand-trenching. Such soils are generally composed of a series of strata, or layers of various natures, which only require to be thoroughly mixed, to render them especially fitted for vine cultivation. Let us suppose the soil to be constituted of eight or ten inches of sandy loam, underneath this a layer of eight inches of gravelly soil, and underlying the gravel a stratum of ferruginous, clay, tough and impenetrable to moisture, of the thickness of six or eight inches; while, under all these is a thick deposit of argillaceous marl of a foot or more. Such a soil, in its natural state, is utterly unfit for vines, the roots could never penetrate the tough clay, and would thus be limited to a surface soil of sixteen or eighteen inches, while the marl underneath the clay, so favourable to the vine, is also unavailable in the natural position of the strata. These constituents of the soil, if properly mixed, would produce a combination of the best kind for vineyard purposes. Such combination can be made only by hand-trenching.

The usual mode of proceeding is, to open up a trench of the requisite depth, say three feet in depth, and the same in width; the soil from this being thrown out to fill the last trench at finishing. The next trench is marked out the same in width, and the earth is thrown into the first, the surface soil into the bottom and each spit in succession until the layers are all reversed; that which was surface is now at the bottom, while the lowest stratum is on the surface. In some cases this mode of trenching answers well enough, where it is not necessary to have the layers thoroughly mingled; but there are others in which it is inadmissible: for instance, the underlying stratum may be a tough clay, which, if thrown on the surface, dries into a hard crust in summer, and in wet weather is so impervious to rain, that not one particle of moisture reaches the underlying soil. This has actually been done, and the result of so injudicious a proceeding as might have been expected, was, to render the ground perfectly sterile. The mode of trenching above described, is very imperfect, in as much as it does not mix the different ingredients, and allow of the action of their various elements on each other, by which their fertilizing property is increased; a thorough mixing, in fact, ought to be our principal aim in trenching. Instead of throwing the different layers upon each other in succession—thus merely turning the soil upside down—a mixture might be effected by opening the first trench of double width, say six

feet, the soil from the next trench of three feet is then thrown into the lower side of the open trench so as to form a sloping surface on which the successive layers are thrown; these are thoroughly mixed as they are thrown out, by means of a mortar rake, or by turning up each layer with a shovel. It is evident that a much more intimate mixing of the ingredients can be effected on the sloping surface than by the usual mode.

From the retentive power of argillaceous marls, it is sometimes desirable to retain them at the bottom of the trench, while the surface ought to be free and open. With this view, it is well to have a considerable portion of gravel or small stones in the top soil, which will cause it to be more easily worked either by the spade or plough in the after yearly tillage of the vineyard.

The mixing of the soil, as above described, is generally all that is required to prepare it for planting, where the ground is level; but where there is a considerable declivity, it is necessary to guard against the evils arising from irregular rain-fall, by terracing the ground. For a minute and accurate description of the mode of carrying out this operation, I have much pleasure in referring to Maro's letters; and as the directions on the subject comprise all the details that can be required by any one wishing to carry out the system, and the book is now out of print, the whole article has been inserted in the appendix.

There are few in these colonies, who will go to the great trouble and expense of terracing for vineyards in the manner there described, and there are not many situations where it is necessary. Indeed were it required in most cases, vine planting could be carried out only by wealthy dilettanti. Nevertheless, the subject of terracing deserves the attention of all who are planting vines, for although they may have no intention of adopting it in its completeness, the perusal of the article will afford many suggestions which may prove useful and may be turned to account in the more simple and less expensive laying out of vineyards in general.

There are numerous localities in these colonies, which possess a soil and situation naturally fitted in every respect for vineyards, and where little labour is required, preparatory to planting the vines. On the river flats and gentle sloping banks of the Hunter, Williams, and Paterson, in New South Wales, are some of the most lovely spots now occupied by vineyards, where the alluvial soil is sufficiently free to allow the roots of the vine to penetrate three or four feet into the ground. Where such soils rest upon a somewhat retentive clay, it is unnecessary to do more than give them a deep trench-ploughing of twelve or fifteen inches, by which the turf and surface weeds are completely buried.

The alluvial banks of the Murray, Murrumbidgee, and other rivers, afford soils and sites which have been fully tested, and have shown their great capacity for

vine growing; and near Adelaide, on the slopes of the Barrosa hills, there are extensive vineyards where the soil was so free, as to require no other preparation than by the plough. There are situations, however, where the soil, though free to a considerable depth, is composed of various layers which require to be more thoroughly mixed than can be done with the common plough, and in many cases there is a lamina of soft limestone within ten or twelve inches of the surface, which must be thoroughly broken up, in order to get access for the roots, to the mixture of alluvium and granular limestone which constitutes the subsoil. This last is particularly prevalent in many districts near Adelaide, and has been found admirably adapted to vine growing.

There can be no doubt that hand-trenching is the best preparation of such soil for vineyard; but the expense attending it is so great, as to lead to the substitution of less costly means of preparing the ground. The subsoil plough has been found to answer so well the end required, the thorough breaking up of the soil to a sufficient depth, that this mode of working the ground is worthy the consideration of all who meditate planting the vine on a large scale.

There are subsoil ploughs of various kinds to be had in these colonies, which will do the work required, if the ground is not unusually hard and stoney. They are made of iron, and although apparently very strong, they will be found unfitted for very stoney rough ground. For working the surface limestone soils about Adelaide, subsoil ploughs have been constructed of the strong hard woods with which these colonies abound. The Peppermint Gum is generally used; the Iron Bark of the neighbouring colonies would answer as well. The beam is cut from a limb of the natural bend, and ought to be at least 9 inches in depth by 6 in width; it may taper considerably at the head, but it requires the strength here given at the body, which has to sustain the principal strain, and is somewhat weakened by the mortices and bolt holes. The two stiles as well as the diagonal and the wooden sole ought to be 3 inches thick. The stiles of course are firmly morticed into the beam and sole. The depth from the bottom of the beam to the ground is 20 inches. From the point of the beam to the ground it is 28 inches, and from the extremity of the handles to the ground 3 feet 4 inches; the whole length of the plough may be 15 feet. The iron work must be of the most substantial kind; the share, above all, must be especially strengthened at the fore part, where the principal bolt pierces it, as this is the part which has to bear the greatest strain. The draught chain and head irons ought to be of proportionate strength.

[Здесь в книге был рисунок деревянного плуга — я опускаю описание изображения]

The advantage of the wooden plough over the iron one consists in its being better able to endure the rough work in stoney ground, and above all, the facility with which it may be repaired. In the severe straining to which it is subjected, the beam is very apt to be broken, but any one, accustomed to the use of the adze, may replace it in a few hours. It is requisite to have one or two beams at hand in

the event of such accident. Such a misfortune, occurring with the iron plough, would stop the work for days, supposing that the damage could be repaired; but there would be probably no hope of resuming operations without procuring another plough.

We shall now proceed to the mode of working the subsoil plough. A piece of ground having been marked out, say 250 yards by 100, a strong deep moulded iron plough draws a deep furrow along the middle from end to end; the plough then returns and throws another furrow over against the first, gathering the mould into a centre ridge; this mould must be thrown on either side as far as can be conveniently done with the shovel. In the trench thus opened, which may be 20 or 24 inches in width by 10 or 12 in depth, the subsoil plough is worked by a strong team of steady bullocks, four or five pairs at least. The handles require to be considerably elevated, in order to make the share of the plough enter the ground, and some difficulty will be experienced in opening up this first furrow in strong ground; indeed the assistance of the pick axe is generally required to complete it. The action of the subsoil plough in stoney ground being similar to that of a strong pick axe, the handles ought to be constantly moved up and down as it proceeds, in order to loosen the stones and allow it to pass on; and to do so effectually it requires two men at the handles. In favourable ground the plough will go down twenty and even twenty-four inches, thoroughly stirring up the soil to that depth, and moving it a foot or more on either side. Occasionally the point of the share gets fixed under a stone, larger and harder than usual; when this happens, by surging upon the handles, and with the assistance of two of the drivers at the beam, the stone may be raised. In this way large flat stones of six or seven feet superficies, and six or eight inches thick, are brought from a depth of twelve or fifteen inches to the surface. Where the plough happens to be thrown out, and passes over a stone, it ought to be drawn back again in order to complete its work.

The quantity of ground gone over with the subsoil plough in favourable soil cannot possibly be more than half an acre a day, and in some cases where the stone is very abundant, it may be impossible to get through an acre in four days; and for this work there are required, one ploughman and driver for the trench plough, with a team of three pairs of oxen; and for the subsoil plough a team of four or five pairs, with two or three drivers, and two ploughmen. Besides these there may be two men required to take the loose stones out of the trench; and when the stone is very abundant, it requires to be moved out of the way as it is raised, and this will entail the further labour of one or two men and a horse and cart. The quantity of stone thus raised is sometimes very great, as may be supposed, where there is a layer of limestone of eight inches in thickness. If one-half of this is raised to the surface, its removal involves much labour. There is, however, this compensation for the labour of raising and carting the stone, that it furnishes the best material for fencing the vineyard. It is only the hardest and best of the stone that ought to be removed, the remainder should be broken small.

The labour and expense incurred by subsoiling in this manner appears great, since it requires six men and nine yokes of oxen to accomplish an acre, under ordinary circumstances, in three days, without taking account of the men employed in raising and carting the stones; but the hand-trenching of the same ground, to the same depth, would occupy the same number of men twenty-six days at a rod a day each.

The above mode of working the subsoil plough is only fit for level ground. Where the ground slopes, it is better to throw the furrows all down the hill, commencing at the foot, and in this case the ploughs must return empty, as it is termed, and commence again where they first started. The time expended in thus returning empty, is not all lost, since the bullocks get rested, and are relieved by the change of motion. Indeed it is sometimes deemed better to work only one way, even on level ground, as the constant drag on the bullocks, when they have no interval of rest, is too heavy for them, and there is not sufficient time to allow the stones being removed from the trenches.

The subsoil plough has been very generally employed in the neighbourhood of Adelaide for the preparation of vineyards, and, where the ground was suited for it, has succeeded well. It is satisfactory to find, that practical vine growers, in other parts of the colonies, have adopted a similar mode of preparing the ground, and have carried out the details in nearly the same manner as we have done in this. The following observations, in a treatise on the cultivation of the vine, by M. Pettavel, of Victoria Vineyard, near Geelong, corroborate so strongly the opinions already expressed, of the efficacy and practical utility of the system, that we recommend them to the attention of readers:

"TRENCHING WITH THE PLOUGH.- This operation is much cheaper than trenching with the spade, and should be adopted wherever the proprietor intends to grow on a large scale. There must be a long furrow and plenty of room for the cattle to turn; the ground must be clear of stumps, roots, and stones, as mentioned in the article on clearing the ground, as any of these things retard the progress and not unfrequently occasion breakage of the machinery, and thus entail the cost of repairs, which is always expensive. Where there is a considerable quantity of soft limestone, the plough may be used with advantage, and the stiff chocolate soil, when trenched with the plough, pulverises more readily and thoroughly than when done with the spade.

"Although I commenced to cultivate the vine in this colony in 1842, and assisted to form the vineyard at Pollack's Ford, it was not 'till 1848 that I could sufficiently throw aside my prejudices in favour of the spade and forked hoe, which I had always seen used in the vineyards of Switzerland, to induce me to adopt the plough as my usual mode of trenching. However, the scarcity of labour in Victoria, the consequent high rate of wages, and the comparative slowness of the return from the time of commencing to invest capital in the cultivation of the

vine, have compelled me to try the experiment, of which I am now able to report the complete success.

"When the land has been carefully cleared by grubbing, or by long continued cultivation of other crops, commence to trench at the lowest part of the ground by a common plough drawn by two strong horses, striking out a furrow; as soon as they have got sufficiently ahead, let the trenching plough, drawn by from ten to twelve bullocks, according to the nature of the ground, and the strength required, follow, going as deep as it can; let it be followed by one, two, or more men, as may be necessary, to remove stones, roots, &c., which will be brought to light, and to throw up and break large lumps which would otherwise fall back and lie in the furrow, and prevent the next sod from turning down well. As soon as the horse-plough has gone to the end of the furrow, let it be drawn back, without entering the ground, to the end from which it started at first; then turn over a slice, if possible of from seven to eight inches, which will fall into the furrow left by the bullock plough; when the bullock plough has got to the end of the furrow, let it be thrown out and turned back as was done with the horse plough; then let it follow the horses as before, and in the course of a few furrows, each being kept well cleared by men following as previously mentioned, the bullock plough will get the full depth of from fifteen to eighteen inches, and the work will go on in the same manner till the piece of ground mentioned to be trenched is completed.

"To make good work there must be plenty of strength. I have this year (1858) trenched fourteen acres; I had never less than fourteen, sometimes twenty bullocks attached to the plough. The soil was principally a chocolate clay, I, however, turned up about five hundred loads of limestone; through this the plough passed more readily than through the clay; the breakage was comparatively small. The plough I made use of was a common iron wheel plough, made very much stronger in every part; the mould-board having another attached to it at the top so as to form a single mould-board of extra size.

"Doing the work in this manner, I am sure that the spade could not do better, neither will any levelling be required after the ploughing has been finished."

This system of trench ploughing here described differs somewhat from that of subsoiling; it is one of the modifications of ploughing for vineyard purposes adapted to particular situations, where the soil is naturally more free and easily moved. A very deep moulded trench-ploughing in such soil has gone down at once twenty inches, and although it could not be said to have turned a furrow, it thoroughly stirred and mixed the soil to that depth. This was of course in very favourable ground which might have been planted at once without any preparation further than clearing the surface. It consisted of a free ferruginous loam mixed with a loose calcareous gravel. It is evident that various modifications of subsoiling and trenching must be adopted in different situations to suit the peculiarities of the soil. One of these which has been found to answer well here is very similar to that used by M. Pettavel. It is an iron subsoil plough

with a projecting wing of four or five inches in width, running from the share obliquely upwards and backwards, which has the effect of bringing up and mixing with the upper soil a portion of the subsoil. This plough is found to do the work required with excellent effect; in soils composed of layers of different matters which require mixing to a certain degree, and where there are no heavy stones to obstruct it, it can be worked with a less amount of strength than the heavy wooden plough already described, and will open the ground to a depth of eighteen inches, when drawn by four horses, and having had a furrow of six or eight inches previously thrown out by the common plough.

We shall now proceed to the laying out the ground for planting, premising that the end we shall keep in view in our first arrangements will be the ultimate working of the vineyard by means of the plough and horse hoe; the tedious and expensive operations of digging and hand labour being altogether unsuited to these colonies. Tillage by the plough must not be looked upon as inferior to that by the spade, and recommended to us only for its saving of labour. On the contrary, if properly executed, it is quite equal to the more tedious process of spade husbandry. In France, notwithstanding the low rate of wages and the force of old prejudices, the plough has been getting into more general use for the winter tillage of the vineyard, and would be more so, were it not for the extremely irregular manner in which the vines are planted. In the Médoc, "for two or three years young plantations are tilled with the plough six times in the year; thrice to open the furrow and thrice to cover it up. Vineyards in general are ploughed four times."*

The site of the intended vineyard, we shall suppose a ten acre block of perfectly level ground, forming a square, whose sides are 220 yards; all that is necessary is, to lay off the rows parallel to the sides, and at sufficient distance from each other, to allow the working by the single horse plough. The space found most convenient for the purpose is six feet; this allows room enough, and does not overcrowd the more vigorous vines suited to warm climates. In colder districts, where the smaller varieties are grown, it may be necessary to have the rows not more than five feet apart, but this is the nearest that can be worked well with the plough. The distance at which the vines are planted in the rows depends, as we shall afterwards see, on the varieties and the soil in which they grow. While some require three square yards for their healthy growth, a square yard or less is sufficient for others. Where it is necessary to plant very close, it is better to place the vines nearer in the rows, rather than diminish the space between the rows. The intention of this close planting in the rows is the formation of a thick bushy foliage over the vines, to protect the fruit from the scorching rays of the sun. The direction of the rows has been made a matter of moment by some. It is said that where they run north and south, the hot winds which blow from the north, or a few points on either side, sweep along the rows unimpeded in their course, greatly to the injury of the vines. If the direction is from east to west, the first few rows suffer severely, if not protected by a hedge or belt of trees; but the further rows suffer less from the blast which sweeps over them transversely, than that which blows parallel with the rows.

It is doubtful, however, if anything is gained by this arrangement. The westerly gales, which prevail in October and November, are particularly injurious to the vine, at this, the time of flowering, and cause many of the bunches to be abortive. The only real remedy against these evils is, the raising of sufficient shelter, by planting belts of trees on the windward sides of the vineyard. Such protection will be more available on level ground, than on uneven or undulating land.

The direction of the rows having been decided on, it will be necessary to intersect the ground by roads or lanes at right angles to the rows to allow access for carts to carry off the produce at the vintage, and their breadth ought to be such as will allow a horse and plough to turn on them while working the ground; for this purpose a space of 20 feet is sufficient. The distance between the lanes ought not to be more than 120 yards; this will be found quite far enough, to carry the produce at gathering, to the carts at either end of the rows. An important service may also be performed by these lanes, where the ground is not perfectly level, in acting as drains to lead the water from the neighbouring land into the vineyard during the seasons when the rain-fall is deficient, and to carry off the superfluous water in very wet years.

To prepare for planting, the ground is marked off accurately at each end of the intermediate rows, by straight stakes of four or five feet in length, fixed upright in the ground. At intervals of twenty or thirty yards along the rows similar stakes are fixed, their position being accurately taken by sight, from the first stake. With these guides, the planting, whether of cuttings or rooted plants, may be conducted by means of a line having marks at the required distances—three, four, or five feet, as the case may be. Where the distance between the vines is considerable—four or five feet—care ought to be taken to have the vines rowed transversely as well as longitudinally in order to admit of cross ploughing, and some recommend the alternate or quincunx form, as allowing also of diagonal ploughing.

This cross and diagonal ploughing is admissible only where the ground is nearly level, and where the vines are not trellised. As the facility of the after working of the vineyard will depend upon the accuracy with which the vines are planted, great attention ought to be paid to the first operations.

Where the ground is sloping, the arrangements of the vineyard are of a more complex kind; and although it may not be requisite to follow out the perfect system of terracing described in Maro's letters, the mode of laying out the ground must be conducted on the same principles; and we shall find in the letter quoted in the appendix, many valuable hints and suggestions which we may turn to account in working on slopes. If we suppose the inclination to be one in twelve as the proposed site, it will be of the greatest advantage to lay the rows

horizontally along the slopes, so that each furrow formed in ploughing between the rows, may retard the flow of the water down hill. To accomplish this effectually, a series of levels must be staked off, from which the rows are to be laid out. When the slope is regular, this will not interfere with the required distance between the rows and their parallelism; but where the slope is irregular, the levels laid down may require the rows to be nearer at one end than the other, but this will seldom be so great as to interfere with the ordinary ploughing.

The levelling may be done by means of a strong mason's level, the base of which ought to be four feet at least; or by a spirit level accurately set in a piece of well seasoned deal 2 inches by 4, and four or five feet in length. A supply of strong pegs, two feet in length, pointed at one end and sawn off square at the other must also be provided. On proceeding to level, two of these pegs are driven into the ground by a wooden mallet, at a distance of three or three-and-a-half feet, and in the direction of the projected line. They are made perfectly level on the top, and serve as a base for the next point, at which a peg is driven; one man remaining at the first pegs to take the sight. If the slope is regular, the first pegs may serve as the base by which all the others are levelled; but when the ground is irregular, the pegs must be fixed as far as they can be sighted from the first, and then another base must be formed by driving two pegs as at starting. In this way the levelling of each area is carried out separately; and when the ground is very irregular, the breadth of these areas must be diminished very considerably. About one hundred and twenty yards was stated as the maximum distance at which the roads might be apart, but it may be necessary in irregular ground to place them at half this distance. It is not necessary to level each row; every fourth, sixth, or eighth may be sufficient, according to the nature of the ground.

A declivity of one in twelve would not require any means of retaining the surface water, further than the plough furrows. But where the slope is greater than this it would be of great advantage to have terraces of stones at intervals of twelve yards; these, if backed with earth would serve to retain the water until it has time to be absorbed. There is here no attempt at terracing, or reducing the ground to a series of levels from one embankment to the other; it is only a series of ditches, at intervals sufficient to impede the course of the water when the slope is great, and to answer this purpose these ditches ought to be closed at the ends to retain the water. The loss of space for the vines which results from this arrangement is very inconsiderable, and will be fully compensated by the advantage gained in the saving of moisture; and by having the vines five feet and a-half apart instead of six, there will be the same number of vines to the acre. The wall and ditch need not occupy more than one yard in breadth, so that the row of vines above may be five feet from the face of the wall, and the row immediately below may be four feet, which would allow room for the plough to work. There is another advantage in these reservoirs: in dry seasons, when it is desirable to give the vines the advantage of all the available moisture they can procure, they serve to receive the streams from the neighbouring ground, which may be conducted into the vineyard as already recommended. The cross roads or lanes formed to gain access to the vineyard during the vintage, also serve as water courses to conduct the water into it, or as drains to carry off the

superfluous water. To this end, they ought to be slightly depressed below the general level, and may be banked across at intervals by stones or other convenient means, to cause the water to run in upon the rows where required. These little embankments must be cleared away when the water is in excess; and as it is impossible to predicate what may be the amount of rain at any time, it is necessary to keep constant watch during rain, to regulate the supply and prevent damage.

The ground having been laid out and staked, the planting may be proceeded with at the proper season. If rooted vines are to be planted the month of June is not too early, while cuttings may be planted somewhat later.

Regarding the expediency of planting cuttings or rooted vines, there is a diversity of opinion. With rooted vines there are few or no blanks from failure in ordinary years, while it is impossible to say what may be the success with cuttings. In favourable years the loss of cuttings may not exceed five per cent., and were it double this, there would hardly be any hesitation with most persons in choosing this the simpler and less laborious method. In ordinary years the loss of cuttings may be twenty-five per cent., or one-fourth, and this ought to be the estimate when a choice is made between the two methods. In a very unfavourable season there may not be ten per cent. of the cuttings alive at the following winter; but in such a season there would also be many deaths among the rooted vines planted out.

There is an advantage ascribed by some to cuttings over rooted vines. It is said that the rooted plant, whose roots have been mutilated in transplanting, cannot be so favourably circumstanced as a vine grown from a cutting, whose roots have never been disturbed, but have retained the original position in which they were thrown out. This advantage may or may not be real; but after three years it would be hard to say which has the advantage in point of strength, the rooted vine or the cutting, planted at the same time under favourable circumstances.

Where cuttings have been planted in the first place, there ought to be a supply of rooted vines ready the following year, to fill up the blanks, and for this purpose beds must be prepared, by carefully trenching a piece of soft rich soil in a damp situation. The cuttings ought to be not more than fourteen inches in length, and laid sloping backwards, in a small trench about twelve inches in depth, in which they may be placed three inches apart. Another trench is then opened about fifteen inches from the first, and the earth thrown into it; in this way the plot is to be planted. To take up the plants the following year, a trench must be opened outside the last planted row, and the earth loosened carefully about the roots. Many of these are so long that there is no possibility of getting them out entire, they must therefore be cut off at a foot or so. All roots within eight inches of the surface must, be cut off close to the stem, and all the shoots must be cut away except the lowest, which is left with a single bud. The planting must take place as soon as possible after the vines are removed from the bed,

and until then, the roots are to be covered up with loose earth. When the vines are to be pretty close in the rows, trenches may be opened the whole length of the rows, but when further apart than three feet, separate holes may be made.

When cuttings are planted out in the vineyard they ought to be rather longer than when planted in beds for rooting and transplanting. From fifteen to eighteen inches is the common length of cuttings, of which two inches may be above the surface; longer cuttings, even two or three feet, have been recommended, but they seem to possess no ultimate advantage, and are much less certain of growing in the first place. The sooner the cuttings are planted after being taken from the vines the better. In the warmer districts of this colony, the month of July is generally preferred for planting, but in a wet season August is not too late. Until they are planted, the cuttings ought to be kept moist by having their butts in water or damp earth, and they are to remain in this state until the moment of planting. The preparation for planting consists in cutting transversely close under the lowest bud and leaving about an inch above the highest. The planting is usually done with the spade which is pushed down perpendicularly about fifteen inches in the spot where the cutting is to be placed; as the spade is withdrawn the cutting is pushed down into the opening; the spade is again put in about two or three inches from the cutting and to the same depth, and the earth firmly pressed up against it. The implement used in Europe for planting vines has been found of great service in this colony. It consists of a blade of flat iron two inches in width and three feet in length, having a cross handle, and resembles the letter T.

After planting nothing further is in general required during the first year, than keeping the ground clean; and at the beginning of winter, before the pruning, it may be dug or scarified. The young plants must be left untouched during this their first summer.

CHAPTER V.

PRUNING.

"Of all the productions of the vegetable world, which the skill and ingenuity of man have rendered conducive to his comfort, and to the enlargement of the sphere of his enjoyments, and the increase of his pleasurable gratifications, the vine stands forward as the most preeminently conspicuous. Its quickness of growth; the great age to which it will live,—so great indeed as to be unknown; its almost total exemption from all those adverse contingencies which blight and

diminish the produce of other fruit-bearing trees; its astonishing vegetative powers; its wonderful fertility; and its delicious fruit, applicable to so many purposes and agreeable to all palates, in all its varied shapes, combine to mark it out as one of the great blessings bestowed by Providence to promote the comfort and enjoyments of the human race.

"From the remotest records of antiquity, the vine has been celebrated in all ages as the type of plenty and the symbol of happiness. The pages of Scripture abound with allusions to the fertility of the vine as emblematic of prosperity; and it is emphatically declared in describing the peaceful and flourishing state of the kingdom of Israel during the reign of Solomon, that 'Judah and Israel dwelt safely every man under his vine and under his fig-tree, from Dan even to Beersheba.' The source of enjoyment thus mentioned to record the happy state of the Jewish nation, may be, with reference to the vine, literally possessed by the greater portion of the inhabitants of this island." If this could be said of Britain, how much more forcibly does it apply to the colonies of the Australian continent, where every cottage may be embowered in vines.

As the dog, in the animal kingdom, is the friend and companion of man, so may the vine, among vegetable productions, be said to be his associate and solace. Like man himself, the vine seems designed for cultivation and improvement; it is culture alone which develops the latent powers and qualities which in its wildling state are never called forth. Like a weak dependent being, we find it in its native wood, clinging for support to its fellow denizens of the forest, festooning their trunks and branches with its beautiful trailing foliage, or hanging in long tangled masses from the lofty boughs. It is this dependence on extraneous support, and the capability of improvement by care and culture, that call forth in man a more than usual interest, I may say affection, for the vine. From no other of the productions of the vegetable kingdom, will his care and attention receive a more grateful return, than from this, his beautiful nursling; it becomes to him almost a sentient and sympathetic being, "a thing of beauty; a joy for ever." If the cultivation of flowers has an ameliorating influence on the heart of man, distracting his thoughts from the carking cares of the world, the culture of the vine is pre-eminently fitted to solace and sooth his wearied spirit.

Coming originally from the cradle of the human family, it has followed man in his migrations into the most favoured regions of the earth, and found a fitting abode with the Caucasian race, in the sunny climes of Southern Europe and Central Asia; and now it bids fair to find in the great South Land, a climate and soil equally suited to develop its most valuable qualities, as the most favoured parts of the old world.

The labour which the vine demands for its proper cultivation, is not of a heavy arduous kind; after the first preparation of ground, the subsequent yearly dressing and pruning may be considered a pastime. The pruning and training require considerable attention, skill, and judgment, and render necessary a

knowledge of the habits of the vine, and of the principles upon which these processes are conducted; but these principles are easily learned, and the native of Britain who never saw a vine until his arrival in Australia, soon becomes an expert pruner under proper tuition. Although the different varieties of vine require very different modes of pruning, yet, the principle upon which the process is conducted is the same in all. A knowledge of the habits and modes of growth of the various kinds is soon acquired, and forms a delightful study to the intellectual man, and enhances his interest and pleasure in the pursuit.

The vine differs from all other fruit-bearing trees, in this, that the fruit and leaves are produced on the green shoots of the same year; and those shoots, before winter, become brown and hard or lignified, and never again produce fruit. The eyes or buds on these shoots, of which one is formed in the axilla or arm-pit of each leaf, send out the following year green shoots, which, in their turn, bear fruit and leaves, become lignified, and so on, each year in succession. This is the course of things in a state of nature, when the vine is left unpruned.

The accompanying illustrations are intended to give the results of the natural growth of the unpruned vine, on the one hand, and of the same vine pruned, on the other:

No. 1, represents part of the shoot of a vine in its summer state. This shoot sprung from a single bud or eye in September, and in twelve weeks had grown to the length of four feet. The leaves grow alternately on the shoot, and at the base of each leaf stalk is a bud, which will send out a shoot the following year. The bunches of fruit grow opposite the leaves. In the end of October or beginning of November these fruit bunches flower, exhaling a sweet perfume. During the flowering there is a slight check to the growth of the shoot, but it soon renews its energies, and pushes out from its extremity until it attains the length of five or six feet. In January all the powers of the plant are put forth to ripen its fruit, and this it accomplishes in warm situations in February or March, and perhaps a month later in colder climates. When the fruit is thoroughly ripe, the stalk of the bunch will be found ripened, brown, and hard, for half an inch or more, where it is attached to the shoot; and this also will have become ripe and woody as far as, and even beyond the highest bunch of fruit. As the season advances, the ripening of the wood goes on, and long before the fall of the leaf in winter, not only is the shoot ripened to its extremity, but even the off shoots, or laterals, if any, are all perfectly ripe or lignified. This will always be the case with a healthy vine in a fine climate, and appropriate soil, and where it has been judiciously pruned.

But it is otherwise in cold climates, as the North of France and Germany, where the vine has great difficulty in ripening its fruit and its shoots before the winter sets in; and as it is absolutely necessary that a portion of the young shoots should be ripe, in order to furnish buds for the following year's shoots, it is the custom to remove all the superfluous parts of the green shoots in spring and

early summer, in order that those which are left may thoroughly ripen. There are few, if any, districts in the continent of Australia, where such a proceeding is required to ripen the fruit and wood, and in the warmer districts such summer pruning is not only superfluous but injurious. To this subject we shall return under the head of vineyard management.

In No. 2, we have the winter state of the same branch, as it is now called. We shall leave it to itself and mark the issue. At the return of spring the buds swell first at the extremity of the branch, and then down to its base; they soon burst and send out shoots on either side to the number of twelve or more, as in No. 3. A few of the buds may not spring, particularly at the lower part of the branch, but the number of shoots is such, even with a considerable amount of failures, that the plant cannot sustain them in vigour. These shoots with their leaves and fruit are, consequently, poor and stunted in growth, and form a marked contrast to the strong healthy shoot of the former year, from which they sprung. Nearly every small shoot sends forth a bunch or two of poor fruit, consisting of little else than skins and seeds. It is easy to imagine the result of another year's growth left entirely to nature. The numerous small branches, formed the previous year, send out shoots smaller than themselves, and in a short time, the vine dwindles away to a wild rambling shrub, unfit to bear fruit for the use of man.

We shall now see what cultivation may do to improve the vine and its produce:

Suppose that the vine, of which No. 1 is a shoot, has increased in vigour and size sufficiently to bear more fruit the ensuing season. A greater number of shoots may be allowed to form, and to this end two buds are left on some spurs where only one was allowed the previous year. We shall cut away therefore all the branch above the small line a in No. X leaving two buds or eyes on the spur. From these eyes spring two healthy shoots, with well developed leaves and a moderate quantity of good fruit; this is represented in No. 4, and forms a marked contrast to the result of the unpruned vine in No. 3.

The principles upon which pruning is conducted, are the same all over the world, and when these are understood the practice is very simple. "Many elaborate directions on this subject have been given by writers on gardening, but these being, in general, based on no definite principles, cannot with any degree of certainty be reduced to practice. The truth is, that although the fertility of a vine depends, in a great measure, on the manner in which it is pruned from time to time, and that for various reasons, the operation may be supposed by those who are unacquainted with the nature of the plant, to be intricate, and to, require a considerable amount of skill, yet the contrary is the fact; for the principle upon which it is performed being kept in view, the whole art of pruning a vine lies in a nutshell." "And as the sole object in view in pruning a vine is to increase its fertility, the best method to accomplish this must be, that which leaves a sufficient supply of bearing shoots on the least possible proportionate quantity of old." Keeping in view the great object in pruning—the increased fertility of the

vine—we cut away all the superabundant wood, and adjust the quantity that is to remain to the capacity of the plant to bring to perfection the next year's crop, and to produce the future bearing wood. We have already stated that it is the new wood of the year that bears fruit, and will never bear again; and as a vigorous vine produces buds, which next year send out fruit-bearing shoots in greater number than can possibly attain perfection, it is necessary to remove the greater part of them, and only retain a sufficient number to give the maximum of fruit consistent with the unimpaired vigour of the vine.

From what we have already stated regarding the fructification of the vine, the old wood can be of no further use, and ought to be entirely removed, except that portion required to form the stem and head of the vine, or the branches to support the young fruit-bearing shoots. Old branches go on year after year acquiring a layer of new wood under the bark and rob the plant of much of its juice that under other circumstances would have gone to improve the fruit-bearing powers of the plant. "Every naked branch of the vine, or one that does not directly bear foliage, diminishes the capacity of the plant for the production of young healthy shoots, inasmuch as it contributes nothing to the growth of the vine, but on the contrary, requires to be fed annually with a certain portion of the elaborated juice of the plant, which would otherwise be expended in the enlargement of the stem, and thereby increase the capacity to mature fruit; and in the extension and multiplication of its roots. If the vine were cultivated for the sake of its wood, the case would be different."*

The extent to which the pruning knife ought to be used must depend upon the strength and nature of the wood formed the previous year; this must be the pruner's guide, and he must rely upon his own judgment in the matter. If he prune too sharp, that is, leave too few buds, these buds send out strong shoots which grow all to wood and give little fruit. But this error is on the safe side; the plant thus acquires strength which will enable it to bear more fruit in future years; and such sharp pruning is always desirable, and indeed necessary, where the strength of the plant has been exhausted by over bearing, the consequence of long pruning. Young vines, which have not come to their full growth, ought always to be pruned very sharp to enable them to gain vigour and strength, before we begin to tax their powers to produce fruit. If, on the other hand, too many buds are left on the vine, the shoots are diminutive, and the quantity of fruit is excessive; the energies of the plant are thus exhausted, and its vital powers injured for years in prospective. No. 8, is an illustration of the extreme of this error where the vine is not pruned at all. When vines are to be rooted up in France, they are pruned very long the last year, in order to produce the maximum of fruit the plants can possibly bear, and this they term pruning à la mort.

It ought to be borne in mind that the formation of seed, as it is the principal function performed by plants, is also the most exacting on their strength; and where from long pruning there is a too abundant crop of grapes, these grapes have a much larger proportion of seeds to the juice than in short pruned vines.

So also in excessively dry seasons the fruit is small and yields little juice, but the seeds are always well developed; it is advisable therefore, in such years, to pluck off the greater part of the fruit bunches, or perhaps the whole of them, when the nature of the season has sufficiently proclaimed its continued aridity about the time of the flowering. The vines would thus be saved the exhaustion which in such a season they must endure from the ripening of a full crop of seeds; and the sacrifice which the wine grower makes of a poor crop of wine is small indeed in comparison with the advantage gained in the future, by thus sparing the vines.

We shall now endeavour to give the practical application of the principles already laid down by a few simple examples.

The first figure here represented in No. 5, is a vine in its fourth winter. We have selected for illustration, not a model vine, but one which has been indifferently pruned in its earlier stages, in order to show how its defects may be remedied by after pruning; the stem is too short and not quite upright. It is of a variety which requires no support, sending up shoots sufficiently strong to sustain their own weight, as well as a considerable amount of fruit. The Carignau, Grenache, and Tokay, are of this kind. The pruning has also regard, in this and the following illustrations, to the mode of cultivation of the vineyard; the vines are made to spring out in a sort of fan shape along the rows, to allow the plough to pass as near as possible.

In No. 5, the dark portions of the figure are the old wood, stem and branches of the vine; while the light are parts of the shoots of the previous summer; these have been entirely cut away except the small spurs here represented with two buds on each. Every bud sends out a shoot the following spring, but two of them having been rubbed off by accident or design the number is reduced to six, as shown in No. 6, which represents the vine in its fifth winter. During the previous summer it has not, according to rule, been allowed to carry fruit, and has therefore gained sufficient strength to bear a considerable number of eyes or buds. A spur of two buds may be left at the base of each shoot, with the exception of that marked a, which is cut off close by the base. The short lines c, c, c, indicate the places where the pruning knife is to be applied. We have therefore five spurs of two eyes at this the fifth pruning.

It is seldom with ordinarily good pruning, that any of the eyes fail; indeed with many of the more vigorous kinds it is a frequent thing to find a double shoot sent out from some of the buds of a sharp pruned vine. We shall therefore allow that all the buds have formed strong healthy shoots, and at the sixth winter the vine will have a growth as shown in No. 7.

The number of buds to be left at this the sixth pruning may be from twelve to eighteen, provided the previous season has been a favourable one, and the plant has improved in strength; and these must be selected with due regard to the required shape of the vine. The pruning, as given in the accompanying figure, leaves seven spurs of two buds each, while the shoots 2, 3, and 9, are cut off close by their base. Should the previous summer have proved a very dry one, such as that of 1859—60, in Adelaide, the small stunted growth of the shoots gives sufficient indication to the eye of the experienced pruner, although he may be ignorant of the nature of the preceding season, of the necessity of excessively sharp pruning. Full well he knows that if he is to spare the vine, he must not spare the knife; he therefore reduces the number of buds to six or even four. As the form of the stock must be constantly attended to, and some of the old wood may require to be removed, an opportunity is afforded, in such cases of excessive pruning, of improving the form of the stock. Any overcrowding which may have taken place from careless pruning, may now be remedied by thinning out some of the superabundant wood about the centre, while the overspreading and straggling branches may be removed at the same time. In the present instance the removal of the branch on the right hand of this vine will be a step towards the improvement of the stem, which we stated was too short; and as the branch on the opposite side, if not removed at present, will probably be taken away the ensuing season, the vine will then present a good upright stem. In the drier portions of Australia nothing is of more importance in vine growing than attention to the sharp pruning required after a year of unusual aridity. In countries where the seasonal variation in rain-fall is so excessive as to present a difference between two consecutive seasons of 2 to 1, or more, it is absurd to follow any system which regulates the number of buds at pruning by the thickness of the stem of the vine.

As the vine increases in age it is evident that the head must require constant thinning out of the old wood; this will be most effectually done by means of a small saw of about fifteen or eighteen inches in length, and tapering from three inches to one inch. After removing a branch or any part with the saw, the rough surface ought to be smoothed off with the knife, when it will heal over so readily in a vigorous vine, as to leave, after two years, a very faint trace of a scar. The knife has hitherto been the implement used in this colony for pruning, but the strong cutting-pliers now used in Europe for the purpose, and called by the French cicateur, will probably take the place of the more primitive implement. The cicateur is used by the Swiss vinegrens of Victoria, and is coming into use in New South Wales.

Besides the system of pruning just described, as that in general use in vineyard cultivation, and which recommends itself by its simplicity, there is another called the long system, in which rods or shoots of the previous year's growth are left of considerable length, and a large quantity of fruit is obtained. Both of these systems have their exclusive advocates among those who have only a partial acquaintance with the habits and mode of growth of the different varieties of the vine; but the universal application of either method to all vines, is altogether inadmissible. A vine of any of the varieties already described, as suited to spur

pruning, if left with rods or branches, of ten- or twelve buds on each, would send out two or three strong shoots from the extremity of the branches, while the lower buds would probably either not spring, or send out small dwarf shoots. At the next pruning we should be forced to leave portions of the shoots at the extremity of the branches, for the following year's growth, and thus bring the vine into a most unsheatly and inconvenient form. On the other hand, there are vines which, if pruned to spurs, will never produce fruit. Year after year, as long as this spur pruning is continued, they will send forth long and strong shoots and abundance of foliage, but few if any bunches of fruit. This is generally the case with the long jointed varieties, those in which the space between the leaves on the shoot is large; but the extent to which long pruning may be carried, depends not on the variety of the vine only, but also, and in a greater measure perhaps, on the luxuriance and vigour with which the plant is growing. In the rich soil of a highly manured garden the quantity of wood to be left for bearing is very great, and it is even found further necessary to impede the flow of the sap, by bending and twisting the long branches, in order to promote the formation of fruit; and in extreme cases, to twist the long joints until they crack and break under the fingers. To provide a supply of strong shoots for the following year's branches, short spurs are left at or near the head of the vine.

No. 8 is given as an illustration of an extreme case of long pruning. The dark parts of the figure represents the wood of the former and preceding years; the longest portions, b, b, b, are termed branches, the shorter, thighs, t, t, t, while the smallest are the spurs s, s, s. All these were formed of the new wood of the former year. The new shoots, the growth of the present year, are represented by the open lines. From the spurs are given off strong shoots, r 1, r 2, r 3, r 5, and r 7,—which seldom show fruit, while from the long branches and thighs are given off shorter shoots, d, d, d, the usual fruit bearers. From the thighs, and even from the long branches, are occasionally given off a strong shoot which from its position may be used as a branch the following year. The pruning, as indicated by the small cross lines, we shall follow from the left hand of the figure. The shoot r 1 is left long for a branch, and the old branch above is cut away, so as to leave only one spur on the lowest of its shoots. The next thigh is entirely removed close to the branch, and long rods for branches, r 2, r 3, are left on the next spurs. The old branch in the centre is cut off just above where a strong shoot has formed; (a strong shoot may spring where it was not expected on a long branch, while spurs intended to throw strong shoots sometimes give a very indifferent one, or none at all,) this shoot, r 4, is left for a branch, and a spur is also left on the small shoot below it. The spur gives a short branch or thigh, r 5, and the old branch is removed, leaving on it a small portion of the lowest shoot for a spur. On the thigh is left the long rod, r 6, and a spur at its extremity, while a long branch, r 7, is left on the lowest spur.

No. 9 gives the vine after pruning, the dark portions indicating the portions left, and the open lines, the wood that has been removed. The branches require to be put into shape by being bent into the proper form. This operation, as already stated, is a beneficial one; indeed the longest branches ought to be considerably

twisted near their base to promote their fruiting and prevent the formation of strong shoots at their extremities.

Between the extremes now given of spur pruning on one hand, and very long pruning on the other, there are of course all possible intermediate grades. The long pruning required in the vineyard seldom admits of more than two or three rods of twelve buds each, and more frequently, thighs of half that length will be sufficient. A little observation of the mode of growth of the different varieties will soon enable the vigneron to determine the pruning adapted to each.

The illustrations, taken from the ordinary run of vines, serve to explain the system of long pruning, but little attention it will be seen has been paid to the original form of the plant. Where vines are cultivated on trellises of considerable height, and due regard is paid to their appearance, a symetrical form is given to them by extending on each side, horizontally, a single branch of four feet or so, and about a foot from the ground. Shoots are allowed to spring vertically from this at regular intervals of ten or twelve inches, and the intermediate buds are rubbed off. No fruit is allowed to form the first year, and the following winter every alternate shoot is left long, and the intervening ones are pruned down to spurs of two or three buds. The long branches are bent into a tortuous form, for the purpose already stated. At the succeeding pruning the long branches of the former year are cut away, leaving only a spur on the lowest shoot, while the strong shoots, of which one has been allowed to grow from each spur, take their places as branches for the coming season. This alternation of spurs and branches goes on year after year, and is a system worthy the attention of those who cultivate the vine for shade. The ordinary mode of treating vines grown for shelter of verandahs, &c., is these colonies, is altogether at variance with the principles of pruning, and very inadequately answers the end in view—the production of a mass of thick foliage. Long branches of old wood, of many years' growth, and studded with spurs, are trained over the space to be covered. These branches, whose combined length is often fifty or sixty feet, rob the plant every year of much of its life blood for their maintenance and growth, besides presenting a very unsightly appearance; they are neither useful nor ornamental. The shoots and foliage are of the stunted growth of an unpruned and wild vine, and the fruit is of the poorest quality. A system of judicious pruning, which left no more old wood than is sufficient to afford the requisite number of buds, would give very different results; and where abundant foliage is wanted, the pruning can hardly be too sharp. As long pruning has the effect of causing the formation of fruit, very sharp pruning causes the formation of wood and foliage. When a vine has been exhausted by overcropping or want of nourishment in a dry year, we restore its energy by pruning very sharply, to cause the formation of wood shoots; and per contra, where a vine is over vigorous, growing all to wood and producing no fruit, we give scope to its superabundant energy by long pruning. If, from any cause, the fruit does not form on the vine, the plant gains a great accession of strength and vigour; and if the ensuing pruning is performed in the usual manner—the same number of buds being left as in ordinary years, when the vine has borne a crop of fruit,—the result will be a very vigorous growth of wood, but little or no fruit; and this will go on until the accumulated energy finds

vent by longer pruning for one year at least. An instance of this came under the observation of Sir William Macarthur in his late visit to Europe. The vines in one district had been frosted down in spring, and the subsequent growth—as usual after this casualty—was wood and foliage, and no fruit. The pruning was conducted according to the old established custom, so many buds to each vine; and great surprise was expressed that no fruit formed the following summer. The cause of the failure they did not even surmise; it was beyond the range of their experience, and to them incomprehensible. So much for routine.

CHAPTER VI.

WINTER WORK.

THE winter work of the vineyard of the second year begins with pruning. Ordinary pruning may begin at any time after the vines are completely denuded of their leaves, and must be concluded before the rise of the sap, which generally takes place about the middle or end of August. If delayed to this time, the sap will flow in astonishing quantity from the newly cut surface, doing great injury to the plant; and as a few warm days will cause the sap to rise at any time after July, it is advisable that the pruning should be completed in the warmer districts before the beginning of August.

The pruning of the vines during the first winter is an operation requiring great care and attention, especially in those cases where it is intended to dispense with stakes in after years. There cannot be a greater mistake than the negligent pruning of the vine during the first year of its growth. It is by the attention bestowed upon it at this time, that a good upright stem is formed; without such a stem it will be impossible to form a plant which will support the branches in equilibrium. There are varieties of the vine which must always be staked or supported, but there are many of the best kinds, suited to our warm districts, which do not require any support after a stem of sufficient strength has been formed. During the first two years at least of all young vines, stakes are required, the stem being too weak to support the mass of folliage which forms on a healthy young vine.

The stakes may be formed of any hard durable wood, and ought to be two inches square, about six feet in length, and inserted firmly a foot or more in the ground. In Maro's letters there is mention made of an instrument used to insert the stakes "which answers the purpose so completely that no vineyard ought to be without one." No such instrument is used in Adelaide. An iron bar, similar to that used for fixing hop holes, is found to answer well.

Having pointed out the necessity of forming a good straight stem, we shall proceed to the mode of pruning required to attain this end.

Where cuttings are planted in the vineyard in the first instance, it is customary to leave two buds above ground; one would be sufficient and would ultimately form a better stem, if it were guarded against accident, but it is thought better to leave two, in case one of them may be destroyed. Where only one bud springs, the shoot from it, in favourable circumstances, is so strong and long that without support it would be apt to bend and break the stem; in such a case stakes may be required during the first summer of the cuttings growth; in general, however, the shoots or cuttings are too feeble to cause any risk of this kind. Where rooted vines are planted in the first instance, their growth is such as to require support during the first summer.

We shall suppose the young vine from a cutting of the previous year, to have sent out shoots from its two buds, and that the two shoots are nearly equal in strength; the question is, which of the two is to be left? It is the usual, and no doubt the best way, to cut away all above the lowest bud, which is intended to throw out a strong shoot which will form the future stem of the plant. In the vineyards of Xeres, in Spain, where the vines are intended to grow afterwards unsupported, the cuttings are very long—three feet at least—and eight or ten inches are left above ground. The number of buds in this case must be considerable—four or five at least—and from each, shoots will probably be thrown out, small in proportion to their number. At the pruning, all these shoots are cut away close to the stem, except the top one, which is intended to form the future head. The number of buds left on this top shoot is not stated, but it is probable that there are at least two. The original cutting is thus made to form the future stem of the vine, and ought to be at least ten inches in length; and from the top of this spring the shoots of the second and subsequent years. Great care is taken in the pruning that the shoots grow equally all round, so as to balance well, and enable them to do without stakes; but particular attention is paid to the staking during the first three years, in order to obtain a good upright stem. The pruning is of course to short spurs.

This system of forming the stem from the cutting is quite opposed to the practice of other countries where more care is bestowed on the vine. There the stem is not formed until a shoot of considerable strength is found for the purpose; the directions given in the Rough Notes are very explicit; the formation of a stem "should never be attempted until by pruning close back, almost to the level of the ground (year after year if requisite), the young vine is in a state to produce a very vigorous shoot which the following year may be pruned to the requisite height. The more upright this stem can afterwards be maintained the better. In pruning young vines, bear in mind that until you have given them the full development you propose, you had better err, rather than otherwise, on the side of over-luxuriance. So long as you preserve the stem and main branches—the skeleton of your vine—in an upright position, never mind how the young wild growth rambles during the season. The more vigorous healthy leaves you can

encourage, the greater will be the extension of the roots, fitting the vine for the production of abundant crops afterwards. Therefore, until the full-bearing state is attained, spare not the knife at the winter pruning; use it rather for the production of very vigorous wood than for fruit, and by this early forbearance you will acquire the title to enjoy a long succession of abundant crops in the future." With these opinions regarding the treatment of young vines, all vine cultivators of any experience will agree. Let us, therefore, reject the practice of Spain, and prune down to the lowest bud. The treatment of the vines during this, their first winter, is the same for all vines, no matter what their ultimate destination,—whether they are to be staked, trellised, or left self-supporting.

If the season has been a favourable one, the blanks may be few, less than five per cent., even of cuttings, and to provide against the failures it is advisable to have a supply of rooted vines to fill up the blanks. In general, however, the failures will be much more numerous—twenty or thirty per cent.—and it would be well to have a sufficiency of plants to supply these. And in a very unfavourable year, such as a drought, there may be an almost total failure, in which case the planting must be gone over again, after thoroughly digging or ploughing the ground.

After the pruning and filling up the blanks, the ground ought to be dug or ploughed with a single horse plough, commencing by throwing a furrow on either side upon the vines, and continuing until the interval is turned up, leaving an open furrow in the centre. This will require four double furrows of nine inches, and the depth may be four or five. Care ought to be taken that the furrow is completely turned, so as to kill all the weeds, and the wing of the ploughshare ought to be the full breadth of the furrow—nine inches—in order to cut off all the roots within five inches of the surface. The intention of this is to force the vine to depend upon its deep roots, whose supply of moisture is more regular and constant, than that of the roots near the surface. The surface roots draw a large supply of moisture during winter and spring, and encourage a growth of wood and fruit, which they cannot support in summer when the surface gets scorched with the dry weather.

The ground is now in a favourable state to receive the winter rain; the centre furrow serves to retain the water, if on a slope, provided the rows have been laid out as directed, to preserve their horizontality. In wet weather it will be necessary to look to the furrows, and see that the water has not made courses of its own down hill. In this condition the vineyard may remain until August; it may then be harrowed and ploughed, the furrows being reversed this time, and gathered into the middle, leaving an open furrow on either side of the rows. If the rows have been planted with great exactness, the plough may pass within four or four and a-half inches of the vines, and thus leave a space of not more than nine or ten inches unturned along the rows. This space must be cleared by a strong hoe in the hands of a careful person, the young buds being exceedingly tender, and breaking off at the slightest touch. In order to keep the ground clear of weeds, it may be necessary to go through the rows with the harrow and

scarifier, and where the vines have been planted on level ground, either square or quincunx form, the scarifier may be used diagonally and transversely.

The harrow used in working the vineyard is a small implement, having a wheel in front, and handles to facilitate its guidance. The breadth between the outside teeth ought to be three feet. The most convenient form is triangular, as represented in the accompanying figure:—

The teeth, thirteen in number, are placed along the diagonal sides with the exception of the three middle ones; the centre tooth is placed some way back on the middle bar; the other two are placed in the cross-bar, a little way behind the centre one. This implement is found to work well and is exceedingly simple of construction.

The scarifier, which will be found useful in clearing off the weeds in October and November, may be constructed on the same plan. The teeth, of which there are seven, are three or four- inches longer than those of the harrow, and the middle one ought to be placed some way back on the middle bar. The teeth are made like those of a horse hoe or common field scarifier, with a share or shovel foot at right angles, and this share ought to be six or seven inches in breadth and pretty sharp. The implement known as the "hop-midget" has been used with advantage in working the vineyard, in the same way as it is employed in the hop grounds of Kent, and other counties of England.

In October and November the young vines send forth their shoots with so much vigour, that they require constant tying to the stakes, and during the summer they must be continually attended to in this respect. Along with the tying, another operation must be attended to at the same time. This is the pulling off any poor or superfluous shoots. Besides the shoot which is intended to form the future stem, there are generally a number of small useless shoots sent out from the base, and even from the roots. All such ought to be pulled off by the sockets, while the shoot intended for growth is carefully attached to the support. If the scarifier is required in the summer, great care must be taken that it does not in any way injure the tender vines. Such summer work is seldom required, except in very wet seasons. Our experience of dry summers has led us to the conclusion that the less the ground is disturbed in dry weather the better.

We now come to the third winter, when the vines have attained a considerable size. The pruning must now be conducted with care, according to the general principles already laid down; no definite directions, as we have already shown, can be given by which all vines are to be pruned, not even when they are of the same age and variety; all must be left to the judgment and discretion of a man conversant with the principles of pruning. I ought here to remark that I have always found the English labourer, after a little instruction, take a particular

interest in his work, and by subsequent observation of the habits and mode of growth of the different varieties, he has often been able to make useful suggestions and modifications in the pruning.

Whatever may be the ultimate design as to supports or no supports, the pruning must still be conducted in the same way for either. Two or three spurs are all that ought to be left on a well-grown vine of this age, since the end in view is not fruit, but the growth of roots and foliage. The tying to the stakes, and thinning out the superfluous shoots, must be carried on the same as on the previous year; while the ploughing, scarifying, hoeing, must also go on in the same manner.

Although the blanks had been filled up the previous year, there may still be a few failures, and these can be replaced by layering, where the shoots are long enough. This is done by bending down one of the longest branches into a trench eighteen inches in depth, in the direction of the vacancy to be filled, and bringing up the end of the branch quite perpendicularly, in the place required, cutting away all beyond two buds above the level of the ground. The earth is then filled into the trench, and the buds are rubbed off that portion of the branch between the stem and the trench; and care must be taken during the summer that all shoots springing from this, or from under ground, be removed as soon as they appear. A good stake must be put in where the layer rises out of the ground, as the shoots spring away with great vigour, and must be constantly attended to.

It is hardly necessary to say, that allowance must be made for the abstraction of so much nutriment from the parent plant, by pruning it very sharp. The following winter the portion of the branch next to the parent vine must be cut off close, and the whole of it put eighteen inches under ground; and the young plant thus cut off from the parent, must be pruned, not according to the strength of its shoots, which have drawn their nourishment from the old plant, but according to the roots formed on the layer itself; these roots are generally not much stronger than would form on a healthy cutting, and therefore, one bud, or two, is all that ought to be left. By this mode of layering we do not disturb the position of the parent plant; but the length of the branch required is so great—seven feet at least where the vines are four feet apart—that it cannot always be carried out.

Where the vine does not furnish a shoot of sufficient length to reach to the vacant space by the above plan, the layering may be effected by the following means:—A trench is dug round the vine to be laid, down to its lowest roots, fifteen or eighteen inches, and this trench is continued as far as the vacancy to be filled. The vine is now bent down into the bottom of this trench, and two branches are brought up,—one in the position of the stem just laid down, and the other in the vacancy to be filled,—care being taken that they come up quite perpendicularly from the bottom of the trench. To facilitate the bending of branches to be laid, they ought to be twisted so as to cause them to crack and split at the part to be bent; without this precaution, they are apt to break off when an attempt is made to bend them.

At the pruning of the fourth winter, the vines will have attained sufficient size and strength to take the shape and form they are ultimately to have. The self-supporting, composed of an upright stem of ten or twelve inches, with a head of five or six spurs; or, if for trellis, three short thighs of three or four inches, or of five or six buds each. The centre one erect, the others at an angle of 45° or so on either side. These will form the basis of the future plant. If all the buds shoot, there may be too many for the strength of the vine; it will then be necessary to thin out a few of them in spring, leaving the strongest, provided they grow in the form designed for the plant. Ten or twelve shoots are quite sufficient for a vine of this age, as it is not considered to be of proper strength to bear fruit until it has attained the full age of five years. There are some vines however, which, during this their fourth year, show a considerable quantity of fruit, and if the vines are strong and healthy, a small portion may be left to ripen; the remainder being removed along with the superfluous shoots at the spring dressing in November.

It is unnecessary to go over again the routine of winter work in the vineyard; nor need we go further with the pruning of the vine, since, at the ensuing winter, that process is conducted according to the general principles already laid down. There is, however, one subject which we must consider and discuss before we leave the vineyard work. This is, the summer pruning.

In the winter pruning a certain number of buds on spurs, thighs, and branches, of the long pruned vines are left, with the expectation that so many will form fruit shoots, and others, wood shoots; and although they generally turn out according to our intention, many buds, which were expected to throw small fruit shoots, send out long wood rods, and vice versa; and notwithstanding all our care in extirpating useless buds, there are numerous small shoots which spring where they were neither expected nor wanted, and which crowd the vine to an inconvenient extent. These useless shoots ought to be removed, and the suckers extirpated about November. Many vigernons are careful not to disturb the vines during their flowering—lest the rough handling and shaking cause their fruit to prove abortive. It is well to adopt their precautions with regard to this, and not handle the vines too roughly; but the risk of injury is not so great as to interrupt the work of the season. At the spring dressing also, it is necessary to thin out the fruit, of which sometimes more sets than the vine is able to bear without injury to itself. In general, with careful winter pruning, the quantity formed is not more than enough; but there are seasons when the vines show an unusual quantity of fruit, and these are often the very seasons when they are least able to ripen it, without an unwanted drain on their energies.

In the beautiful, but disastrous rainless winters, which have more than once visited South Australia, the vines invariably show a great number of bunches, more than in a favourable year they ought to be allowed to bear; and if the season prove a dry one—as it has always done after such a winter, the vine will perform its primary function of ripening its seed; but this seed will constitute the

chief part of the fruit, the pulp being deficient in quantity and inferior in quality. In Europe, a warm dry summer is always considered a good vintage year, so far as quality is concerned: but an ordinary summer in Australia, more particularly on the southern coast, is drier than the driest known in Europe. In our more arid summers we cannot expect the healthy functions of the plant to be carried on with the same success as in seasons of ordinary moisture, nor need we feel surprise at the grape juice being deficient in its most important primary constituents.

It is only in dry situations that the fruit is thus below average quality and quantity; where there is a sufficiently moist subsoil, and in what would be considered swampy ground in Europe, the crop, in such a season, is not only abundant in quantity but also excellent in quality.

When the nature of the weather in November is such as to indicate continued drought, after a rainless winter, it is advisable, in dry situations, to remove the whole of the bunches at the time of the spring dressing: and even in situations enjoying an ordinary amount of moisture, the quantity of fruit left on the vine, in such a season, ought to be small. The sacrifice thus made is trifling, when compared with the gain in the future. By allowing the vine to ripen a full crop (of seed chiefly, be it remembered) in such a season, we exhaust its energies to an excessive degree; and it will require several years of sharp pruning, and loss of crop, to restore it to its original vigour and strength.

The above, which is the legitimate spring dressing required in every case, is very different from the summer pruning followed in the northern wine countries of Europe, and introduced here by vignerons from those countries. In cold climates, the vine has great difficulty, not only in ripening its fruit, but also in bringing its shoots to sufficient maturity. Unless the shoots are perfectly lignified before the fall of the leaf, they wither and die in the winter, and no buds are left for next year's growth. To insure the ripening of a portion of the shoots, the greater part of them are removed early in the summer, and those which remain are topped or pinched off a few leaves above the highest bunch of fruit. Many of the leaves are also removed to allow the access of the sun rays to the fruit, in order to ripen it. This system of mutilation, which is called summer pruning, has been introduced as just mentioned, into these colonies, where certainly there is no need of any artificial aid to ripen the shoots; and it is a common thing to see fine, vigorous vines tied up each into a bundle round a stake, and lopped off all round into a symmetrical column, every stray branch which shows beyond the prescribed limits being carefully removed.

There is, of course, a reason assigned for the practice, sufficiently plausible to cause its being adopted to the extent it has been in Australia. It is said that, by removing all the superfluous shoots, we throw into the fruit the sap and nourishment which would have been expended uselessly on the leaves and wood, and thus greatly augment the quantity, and improve the quality, of the

fruit; while we save the expenditure of the nutritious fluid on the unproductive and useless leaves and shoots. Such arguments indicate the most extraordinary ignorance of the nature and proper functions of the leaves of plants. "Leaves expose the fluids of the plant to the influence of the air and light, and their spiral arrangement enables them to do so effectually. They are concerned in the elaboration of the various vegetable secretions, in the formation of wood, and in the absorption of fluid and gaseous matters. A plant, by being constantly deprived of its leaves, will ultimately be destroyed. On this principle, weeds, with creeping stems and vigorous roots, which are with difficulty eradicated, may be killed."

The leaves of plants are the important agents in the chemistry of nature, by which the atmosphere is maintained in a state of purity to support animal life. Plants through their leaves absorb the carbonic acid, or so act upon it, that the two elements of which it is composed, the carbon and oxygen, are separated, the oxygen being restored to the atmosphere, while the carbon is taken up by the plant, and, entering largely into the composition of its juices, affords material for the extension of all the parts of the plant. In plants of rapid growth, the amount of carbon required is much greater than can be supplied by the soil: such plants are, therefore, provided with abundant foliage, in order that they may obtain their nourishment from the air; and by removing the leaves from plants, we take away their means of growth.

In further confirmation of the importance of the leaf in the economy of plants, we have the following authority:—"The power of absorbing nutrient from the atmosphere, with which the leaves of plants are endowed, being proportionate to the extent of their surface, every increase in the size and number of these parts is necessarily attended with an increase of nutritive power, and a consequent further development of new leaves and branches. Leaves, twigs, and branches, when completely matured, as they do not become larger, do not need food for their support. For their existence as organs, they require only the means necessary for the performance of the special functions to which they are destined by nature; they do not exist on their own account." *

"We know that the functions of the leaves and other green parts of plants, are, to absorb nutritive matters from the atmosphere, and, with the aid of light and moisture, to appropriate their elements. These processes are continually in operation: they commence with the first formation of the leaves, and do not cease with their perfect development. But the new products arising from this continued assimilation are no longer employed by the perfect leaves in their own increase: they serve for the formation of woody fibre, and all the solid matters of similar composition. The leaves now produce sugar, amylin or starch, and acids, which were previously formed by the roots, when they were necessary for the development of the stem, buds, leaves, and branches of the plant.

"The organs of assimilation, at this period of their life, receive more nourishment from the atmosphere than they employ in their sustenance; and when the formation of the woody substance has advanced to a certain extent, the expenditure of the nutriment (the supply of which still remains the same) takes a new direction, and blossoms are produced. The functions of the leaves of most plants cease upon the ripening of their fruit, because the products of their action are no longer needed. They now yield to the chemical influence of the oxygen of the air, generally suffer a change in colour, and fall off."

It is quite unnecessary to adduce further testimony to prove the importance of the leaf in the vital economy of the plant. I shall, therefore, conclude with the following practical observations of Sir W. Macarthur, in the rough notes or comments upon the Geelong Prize Essays:

"None of the Essays indicate clear views with regard to the principles upon which the summer treatment of vines should be regulated, nor of the office the leaves are appointed to perform.

"Dr. Lindley has wittily observed, that he who should remove from a plant in full bearing a portion of its leaves, with the view of hastening the maturity of its fruit, would be acting with about as much reason as one who should take out part of the lungs and bowels of an animal, by way of improving its digestion.

"Let us endeavour to add a few maxims and general principles.

"When the summer is sufficiently warm and prolonged to ensure the perfect maturity of the fruit, the more healthy leaves the vine is enabled to develope and preserve, the greater the crop it is capable of bringing to perfection.

"A shoot, whilst its leaves are in a state of growth, acts as a drain upon the resources the plant derives directly from the soil; but each leaf, having once attained its full size, serves as an organ to elaborate the juices, and absorb moisture during the night and in damp weather, by means of its stomata, or mouths placed on the under side: it will also, by the same means, absorb nutritive principles from the atmosphere.

"The prolonged health and vigour of any particular leaf has important influence upon the bud at its axil; laterals may also serve to feed the bud close to which they spring, but, if vigorous, they must interfere with its development. In such case, if the buds be required to be retained at the next pruning, the laterals in connexion with them should be shortened or removed.

"The leaves situated near the base of bearing shoots have a much more important influence in the nourishment and ripening of the fruit than those situated towards the extremity. The former, as every one knows, is placed in almost immediate relation to the bunches.

"Leaves to any considerable extent deprived of the action of light and air, cannot continue to perform healthy functions. The more light they have the better.

"Although, therefore, in climates most favourable to the vine, it should be encouraged to develope largely its summer growth, this object should not be pursued to the injury of the more important leaves close to the fruit, which also have the office of feeding the buds which, for the most part, are to produce next year's crop of fruit.

"To remove, or shorten, to any considerable extent, the shoots of the vine, after the leaves are fully grown, may have become advisable, but only in consequence of previous injudicious treatment. They ought to have been removed or shortened at an earlier period of growth. So also with leaves which it may have become advisable to remove that the fruit may be exposed to more light; the vine should not have been permitted to grow in such form as to render this requisite. But to stop or pinch off the ends of growing shoots which are showing fruit, is different, and often beneficial. It may, however, be adopted to an extent which will do great injury to the vine. The first effect of early stopping, say, at a joint or two above the uppermost bunch upon a shoot, is to cause a portion of the vigour, which would have been employed in its rapid extension, to be diverted to the development of the bunch and the leaves which are retained. By the same process the laterals which usually are produced upon healthy shoots, are forced out prematurely.

"If the fresh shoots, which will soon take the place of the original leader, be again removed, or closely pinched back, the bunches of fruit will no doubt be still further forced forward; and this system may be the best where, as in forcing houses, a wholly artificial state, as well at root as of the atmosphere in which they grow, is adopted. In such case the smaller number of immensely developed leaves is made to do the duty of the greater number which would naturally be produced, and which, under glass, could not be sufficiently exposed to light and air to perform their functions properly. But, in a climate such as we for the most part have to deal with, such a system will tend to the ultimate injury of the vines. As the shoots are permitted to extend, so also will the roots, penetrating every favouring crevice and vein in the successive strata underneath to an unsuspected depth, thus placing at command stores of moisture and other elements of growth to be called into requisition when the parching heats of summer render them necessary. Vines which, on the contrary, have been restrained to a mutilated summer growth, with its few attended leaves, will not

have a comparatively extensive system of roots. Can it be supposed that they will be able in the same degree to support the effects of a dry summer, or to bring to maturity such heavy crops as those which we will assume to be trained so as to have ample and luxuriant growth? We will imagine these last to be managed so as to form walls or banks of rich foliage five or seven feet high—nowhere so crowded as to deprive the interior and lower leaves of healthy colour and action, and after the young growth has filled up the area allotted to it, that the first growing young shoots are brushed off with the knife or hook as often as requisite until the increasing drain of the swelling bunches of fruit becomes sufficient to retain within reasonable bounds their tendency to grow. In such condition, I venture to assert, a plot of vines would be far more favourably circumstanced to produce larger crops of perfectly matured fruit, uninjured by the vicissitude of the seasons, than they can be when cramped in their growth by perpetual close stopping. Let not the inexperienced husbandman, however, suppose that because the system of close stopping (expedient under glass where the atmosphere is often so damp as to promote the formation of young roots all over the stem and old branches of the vines) is condemned as unsuitable to the requirements of a hot, and often dry and arid climate, that stopping, under all circumstances, is injurious—quite the reverse—but let it be done with judgment, and never so as to prevent the vines from reaping the advantages of ample and extended summer growth. In the early growth, where the sap is forcing the rapid extension of the shoots, it is often advisable by stopping them to check their over-rapid extension; but, beware how you bring them into an over-crowded state—thin out sufficiently and in time to afford to each important shoot its necessary share of light, and by no means continue to shorten them, or prevent the formation of ample foliage. If the luxuriant state of your vines should have induced you at the winter pruning to leave long rods of bearing wood (which is often advisable to reduce over vigour), then you will probably find it necessary, besides thinning out the young shoots from them to prevent overcrowding, to keep almost all the rods closely stopped a joint or two above the uppermost bunches. This will not interfere with the development of foliage recommended, which should be as ample as is consistent with the healthy action of the important under leaves."

Before leaving the vineyard management, we have to consider the subject of vine supporters. The ordinary mode of supporting the long shoots of the vine hitherto used has been a very unsatisfactory one; so much so, that some have doubted whether it was not better to leave the shoots to spread and ramble about at will than to cramp them up by tying them round a stake, and mercilessly smothering the greater part of the leaves. The stake answers very well when the vines are young, and the shoots few in number; but, when the growth is luxuriant in a full grown vine, it is impossible to attach its shoots to one stake, without utterly destroying most of the leaves by over-crowding. The only way to obviate this evil is to erect trellises—a proceeding hitherto too expensive, when wood was employed for the purpose, to be generally adopted in the vineyard. Since the use of iron wire for fencing purposes has become general, it has been introduced with excellent effect into the vineyards of Europe; and has also been employed successfully in these colonies.

In affording support to the vine shoots, there are two objects which we must have in view: first, the free and perfect exposure of the leaves to the air and light; and, secondly, the protection of the fruit from the scorching rays of the sun. On a stake, where the shoots are all huddled up into a bundle, neither of these ends is obtained; but, by spreading out the shoots espalier fashion, we allow sufficient circulation of air among the leaves, while these, by this arrangement, form a complete shade over the fruit.

In the formation of these trellises, the small sizes of iron wire, Nos. 12 and 14, may be used, and the posts need not be nearer than ten yards. According to the size and nature of the vines, they may require two or three wires—in general three are needed; and the distance of these from the ground, and from each other, must depend upon the form of the plant, and the luxuriance of its growth. Where the stem of the plant is fifteen inches in length, there are no shoots which require support nearer than thirty or thirty-six inches from the ground; the lowest wire may therefore be placed here, while the other two may be placed at intervals of fifteen inches. Where vines are small in growth, and two wires may be deemed sufficient, the lowest may be placed a little nearer the ground, and the other eighteen inches above it. Vines thus supported, require much less labour to train them and keep them in order in summer than those attached to stakes; the shoots readily cling to the wires by their tendrils, and need no other means of attachment. Where thus trained, they form a perfect canopy over the branches of fruit, which hang suspended in a dense mass of foliage. When wet weather sets in during the ripening, as frequently happens in New South Wales, there is danger to the fruit in having the foliage too thick about it, and every precaution is necessary to prevent the rotting of the grapes, by affording free circulation of air between the ground and the bunches. To this end the vines are kept free from foliage two feet from the ground. About Adelaide, rain, at the time of ripening is a rare occurrence, and wet weather is unknown. We therefore do not fear any bad effects from an envelopment of the fruit in foliage. The finest fruit is always that which is most thoroughly protected from the action of the sun's direct rays.

Sir W. Macarthur, who has tried the system of wire trellising, is so satisfied with its superiority to every other mode of training vines, that he strongly recommends its adoption, and gives an estimate of its expense. Where the rows of vines are six feet apart, 7,260 yards of wire will be required to form a three-wire trellis an acre. Of size No. 12 there are about 1,155 yards to the cwt.; and No. 14, about 1,866 yards. Of this last, rather less than four cwt. would suffice. In England, the price for the best galvanised of this size may be about thirty shillings per cwt, but we may allow forty for its cost here. The posts, of which 250 are required, at ten yards apart, would add considerably to the expense; but, it is probable that in most situations the cost of good stakes, of which 2,420 are required for vines three feet apart, would exceed that of the wire and posts of a three-wire trellis; and, allowing that the first outlay was in favour of stakes, we

cannot doubt that the wire will be the most durable and cheapest in the end, independent of its superiority for the purpose intended.

CHAPTER VII.

FERMENTATION.

THERE is not, perhaps, any process connected with vine growing, which appears so formidable to the inexperienced, as fermentation,— the conversion of the grape juice into wine. To the uninitiated it is replete with mystery, and is supposed to require for its favourable completion, a large amount of skill and experience to be acquired only by long practice. The apparent complexity is further increased by the chemical and scientific terms made use of in treatises on the subject; terms, which we shall endeavour, as far as possible, to dispense with. Wine fermentation is by no means so complicated or difficult as the brewing of beer; a process more or less familiar to every housewife in these colonies, who manages with success the fermentation of her sugar or treacle beer; which, being in great measure an artificial operation, requires a certain amount of skill; whereas, the juice of the grape ferments naturally, and needs little or no assistance from art, further than the vessels required to contain it.

A quantity of grapes thrown, stalks and all as they are gathered, into a vessel, and left entirely to themselves, undergo the necessary change, and in two or three weeks, wine perfectly fermented, may be drawn off, leaving behind, the skins, seeds, and stalks. This mode of wine making has been tried with perfect success, both in Europe and Australia, but has not been any where adopted. It is found not to be economical, as may be supposed, the quantity of wine produced being smaller than by the ordinary method of crushing the grapes and expressing the juice.

Much light has been thrown on the subject of fermentation by modern chemistry, and the rationale of the process is now given with astonishing precision; but the results of this knowledge are more applicable to the fabrication of beer, and the fermentation of vegetable products for distillation, than to the more natural process of wine making from the grape. Given, a certain amount of sugar or saccharine matter, the chemist can predicate with exactness and certainty, the results of its fermentation; so much alcohol and so much carbonic acid. But with grape juice it is another affair; there is here no single substance, like sugar, having a definite and invariable composition of so many atoms of oxygen, hydrogen, and carbon; every one of which the chemist can give a definite account of, in the resulting new compounds, —alcohol and carbonic acid. On the contrary, the grape juice contains a great variety of substances which exert a powerful influence on the fermentation of wine, and which no amount of human knowledge, perhaps, will ever perfectly comprehend. These extraneous

substances, if we may so call matters, some of which must necessarily be always present in the grape, are found to be ever varying in their relative proportions. And this variation depends not only on the different kinds of the grape and variety of the soil, but also upon the difference of season upon the same vines growing on the same soil. Hence the immense variety in the qualities of the resulting wines; qualities which it is yet beyond the power of man to produce with the aid of modern science, notwithstanding its proud eminence. "If the practice of fermenting the juice of the grape is as old as the deluge," says M. Maumené," Noah, its first author, knew how to do it, par la grace de Dieu, without understanding it. His successors have made wine, and now and then of the best, even to the end of the last century, still in the same ignorance. At that period our illustrious Lavoisier, the immortal creator of modern chemistry, traced with his powerful hand the foundation of the theory. His followers have perfected his work, and today the edifice is so far complete that there is now no excuse for him who lets his grapes be lost." More than half a century has passed since the time of Lavoisier, and notwithstanding all the vaunting of modern chemistry, the greater part of the wines of France—the cradle of that science—are made by this same grace de Dieu.

It is a notorious fact that modern science has not found its way into the cellar of the Vigneron, who follows exactly the same routine his fathers have pursued for centuries; a routine, doubtless, which has been handed down from the ancient wine maker of M. Maumené. From certain modes of conducting their vintage are obtained certain results; and these results are so very satisfactory, and, in general, so unvailable, that it need not surprise us to see the knowledge of the man of science held in little esteem by those who produce the exquisite wines of Burgundy and Champagne. Placed in other circumstances as to climate, soil, &c., their routine is of no service; and it is here that general principles come into use, and we are bound to receive the teachings of science, so far as it has thrown light upon the nature and rationale of fermentation.

It would be quite out of place here to enter into a minute chemical investigation of the theory of fermentation, but it will be expedient to give such a description of the process, and the changes undergone by substances during their conversion into new products, as may be understood by those who have had no opportunity of becoming conversant with modern chemistry, and for this purpose we shall take an illustration from some of the most familiar processes of ordinary household operations.

The juices of nearly all sweet fruits, if exposed some days to the air, at an ordinary temperature, begin to undergo certain changes; air bubbles begin to rise to the surface—at first slowly; they soon increase and produce a hissing noise, and eventually the air rises so rapidly as to cause a violent ebullition, from which it has obtained the name of fermentation or boiling. The air thus given off during the process, is carbonic acid gas, or fixed air; the same that is formed in the lungs of animals by respiration, and also during the combustion of wood, coal, and other substances containing carbon.

In a few days the violent action ceases, and when we examine the resulting fluid, we find it has completely altered its character. It is now no longer thick, sticky, and sweet, like the fruit juice, but has become thin and limpid, or, to use the common technical term, attenuated; it has also acquired a peculiar pungent taste and smell, owing to the presence of alcohol or spirit formed during the fermentation. This is entirely a natural, spontaneous process, requiring nothing from art but pressing out the juice, and much good wine is thus produced.

Let us take another process of fermentation sufficiently familiar. Sugar- beer and ginger- beer are made by dissolving sugar in water—one pound, or one and a-half to the gallon, and an infusion of hops or of ginger is added; or the hops or ginger are boiled with the sugar, and the liquid is allowed to cool. In either case it is merely a solution of sugar, flavoured with hops or ginger. This solution is required to be changed by fermentation into beer. Of itself, it will not ferment, but if we may mix with it a certain quantity of the froth which forms during the fermentation of malt beer, or that which is the result of the spontaneous fermentation of fruit juice, and known as yeast or barm, the fermentation, under ordinary circumstances, will commence, and go on until sweetness has disappeared, and the liquid has been changed into beer, or a weak mixture of spirit and water. This fermentation is the same as the spontaneous one of fruit juice, and the result the same—water and spirit, with the flavouring principles. When the process is completed, the yeast will be found lying at the bottom of the vessel, but it has changed its properties; it is insoluble, and is unfit to excite virous fermentation again.

Should more yeast have been added to the solution than was just sufficient to convert all the sugar into spirit, some of it will remain in its original state, fit to cause the fermentation of more sugar, and if it has not this legitimate scope for its energies (for it will not remain at rest), it will bring about another change, or fermentation, by which the spirit, formed during the first, is converted into vinegar. During this second, called acetous fermentation, the access of air is required during the whole process; and if the air is perfectly excluded from a liquor which has undergone the first or virous fermentation, but which still contains some of the yeast or ferment, this yeast can do no harm, so long as it is shut up from the atmosphere. The first or virous fermentation, on the other hand, may go on after it has once begun, but more slowly, although air is altogether excluded.

If the quantity of yeast added in the first place to the solution of sugar be insufficient in quantity, part of the sugar will remain unchanged, and give sweetness to the resulting liquid.

This brings us to the consideration of the nature and properties of the substance by which these changes are effected, the ferment; a subject of the utmost

importance to all who have to conduct fermentation under any circumstances. But, as a preliminary to such investigation, we shall first consider briefly the properties and composition of the substance to be changed by fermentation, the rationale of that change, and the resulting compounds: we shall then be better prepared to enter on the inquiry into the nature of that mysterious agent, the ferment, by which the change is effected.

Sugar is the substance from which is formed the alcohol, or spirit, during vinous fermentation. Other substances are also employed to produce alcohol, starch, for instance; but these must first undergo the conversion into sugar, before they will produce spirit.

Of sugar there are many varieties, according to the sources from which it is obtained; but they may be all included under two divisions.

The first is that familiar to us in the common sugar of the sugar cane, and is characterized by its forming prismatic chrystals, and its great sweetening power. Sugar of the same kind, and not to be distinguished from it by chemical analysis, is produced from beetroot, and from the juice of the maple tree. The sugars from these sources are classed together under the name of cane sugar.

The other variety, known as grape sugar exists in the sweet juices of fruits, and may be produced artificially by the action of diluted mineral acids upon various organic matters. When farinaceous substances, such as raw grain, are used in the manufacture of spirit, the starch which these contain is first converted into grape sugar by the ferment, before it will undergo the required ulterior change into alcohol. Grape sugar forms cauliflower concretions, but not true crystals, and in sweetening power is very inferior to the cane sugar. If the sweetness of cane sugars be represented as 100, that of the grape sugar is only 60. Grape sugar at once undergoes the change into alcohol under the action of ferment, while cane sugar must pass into the state of grape sugar under the action of the ferment before it will undergo the alcoholic fermentation.

The difference in the chemical constitution of the two sugars is very trifling. That of the grape sugar is thus stated:—

Carbon, 36.36 Hydrogen, 7.07 Oxygen, 56.57

According to their chemical equivalents we have

Carbon, 900 C.12 Hydrogen, 175 H.14 Oxygen, 1400 O.14

A part of this is the water of crystallization, which may be driven off by a temperature of 250°, and the constitution of the anhydrous sugar will then be

Carbon, 900 C.12 Hydrogen 150 H.12 Oxygen, 1200 O.12

Under the action of ferment these arrange themselves into the following new combinations,

Sugar, C.12 H.12 O.12 Alcohol, C.8 H.12 O.4 Carbonic Acid, C.4 0.8

Alcohol, the principal product of vinous fermentation, is the substance above all others whose properties we ought to be acquainted with. It is best known in the form of spirits, a mixture of alcohol and water, under the names of brandy, whisky, gin, rum; all similar in composition, and differing only in the flavouring matters which give them their distinctive characters. Alcohol, in its pure form, is only met with in the laboratory of the chemist; even in the strongest form in which it can be obtained by repeated distillations, it still contains a considerable portion of water. Alcohol is lighter than water; and we ascertain the relative proportions of water and alcohol in a spirit, by weighing a given quantity, and comparing its weight with that of the same quantity of water. If we weigh, in an accurate balance, the contents of a vessel of pure water, and then filling it with proof spirits, weigh it also, we shall find the spirit lighter than water, and bearing to it the proportion of 923 to 1000; and this is called the specific gravity of proof spirits. Alcohol boils at a lower temperature than water, and we are thus enabled to separate them. If we heat, in a close vessel, some fermented liquor, wine, or beer; before the temperature rises to the boiling point, 212° Fahr., the spirit begins to rise in vapour; and if it is conducted into a close vessel kept sufficiently cool, this vapour condenses into a liquid, which is the spirit. The alcohol in this process, known as distillation, is mixed with more or less water, according to the original strength of the liquor experimented on. The first spirit which comes off during the process, is the strongest, and it gradually becomes weaker until nothing but water remains. By redistilling the spirit again and again, it may be obtained of greater strength, but can never be altogether deprived of water by such means. The strongest spirit that can be got by repeated distillation, has a specific gravity 825, compared with water as 1000, and at this strength it contains still eleven per cent. of water. To deprive it of this water, and bring it to a state of pure alcohol, it is necessary to mix with it in the still, substances which have a strong attraction or affinity for water, such as dry carbonate of soda, or muriate of lime; and then it may be obtained of a specific gravity as low as 791. This, which is called absolute alcohol, boils at 1681 Fahr.

Alcohol cannot be frozen at the lowest temperatures, hence its utility in the construction of thermometers for measuring extreme degrees of cold. Mercury

becomes a solid metal at 40° Fahr. It is the alcohol in wine that enables it to resist congelation during the cold of a European winter. It requires a temperature of 21°, or 11° below the freezing point of water to cause the watery part of the wine to freeze.

Alcohol is highly inflammable, and its vapour, diffused through the air, ignites with an explosion on the approach of flame; hence the danger of bringing a lighted candle near a cask containing spirit, or an empty cask rinsed with spirit. Its combustion reduces it to water and carbonic acid.

When alcohol and water are mixed, they suffer condensation or diminution of their volume, which causes a rise of temperature. This condensation is greatest, when 54 per cent. of alcohol and 46 of water are mixed; it then amounts to 3.77 per cent. Proof spirit is a mixture of equal parts of water and alcohol of sp. gr. 825; but the mixture, instead of giving the medium between alcohol and water, 912.5, is really 923, in consequence of the condensation.

Proof spirit and alcohol, when kept in bladders, become concentrated; the water escapes through the coats of the bladder, while the spirit remains. In this way alcohol may be rendered almost anhydrous, or free from water.

Alcohol, when exposed to the air, readily undergoes the change into vinegar; and this change is effected the more readily the more it is diluted. The chemical constitution of alcohol, as given by Ure, is

Carbon, 52.66 Hydrogen, 12.90 Oxygen, 34.44 100.00

Carbonic acid gas, the other product of vinous fermentation, plays so important a part in the making of wine, that its properties ought to be known to the wine maker. This gas has neither smell nor taste; and being also colourless, resembles, in every respect, so far as our senses can take cognizance of it, pure atmospheric air. We can only judge of its presence by certain chemical phenomena, and it is easy to understand how, under such circumstances, we may be exposed to breathe it, even pure, without being at all aware of the danger, for it is a deadly poison when inhaled, and is often the cause of fatal accidents in wine countries. It will not support combustion, and immediately extinguishes flame. A lighted candle immersed in it is quenched instantly, as when plunged into water.

One of the most remarkable characteristics of carbonic acid is, its great weight compared with atmospheric air. This property causes it to descend into the lower part of cellars and vessels, where it accumulates, the air floating upon it, as oil

upon water; from this arises the dangers of entering such places without taking the precaution to ascertain whether or not this gas is present, by first introducing a lighted candle. These properties of carbonic acid gas are easily demonstrated by the following simple experiment:—Into the top of the vat in full fermentation, in which the gas has been allowed to accumulate undisturbed, dip any elongated vessel of the size of a quart or so, and, by care, it will be brought out full of carbonic acid gas. There is nothing in the appearance of its contents to indicate that it contains any thing but atmospheric air; but if we pour it carefully over another vessel in which a lighted taper is suspended, the gas flows into it, displacing the air, and extinguishing the taper—and in this way the one vessel is emptied into the other.

If this vessel is now turned over on one side, to allow one half of the carbonic acid gas to escape, we shall have a proof of the complete separation of the gas from the air by inserting again the lighted taper. In the upper part of the jar, the taper burns with ease, but as it is immersed further, it reaches a point at which it is instantly extinguished, thus showing a surface as defined as that of a fluid.

There is one property of carbonic acid to be enumerated, of the greatest importance to the wine makers, and which has, perhaps, not received the attention it deserves. This is, its power of preserving wine, beer, and other fermented liquors, from the acetous degeneration. A power which it owes to its excluding the atmospheric air. "The most important function of the carbonic acid is, its preventing the absorption of air by wine, and all the consequences of that absorption; the formation of vinegar, and almost all the maladies to which wine is liable. On this account we cannot be too careful to preserve it in the wine. In fact, as long as wine is saturated with carbonic acid, it is nearly impossible for the air to gain access to it, and all further change is thus effectually prevented." To this subject we shall revert under cellar management.

There is yet another quality of carbonic acid we have to notice; its powers of holding various matters, such as the earthy salts, tartrates, and phosphates, in solution, thus preserving the transparency of the wine. When deprived of their carbonic acid, sparkling wines and malt liquors also, generally become turbid.

Having considered the nature of the substance which undergoes fermentation, and the two chief products of that change, we are now in a position to enter into the consideration of the agent by which that change is effected; and here I must warn the reader, that he will find the result of his enquiries far from satisfactory. Of the nature of the interior working, by which the yeast or ferment, operates on the sugar, to cause its conversion into two new substances, we are entirely ignorant. Like vital actions, it is known to us only by its outward phenomena and results. There are, however, many of the circumstances attending it which modify and control the action; these are especially worthy of study and must now engage our attention. "This decomposition of sugar, this alcoholic fermentation, sufficiently simple in itself, is produced by an agent whose

influence is still a mystery to us. Sugar alone, or in solution in pure water, will never undergo the change. It is in vain that we leave to themselves solutions of sugar of every diversity of proportion, and at the most suitable temperatures; not even the sugar of the grape will, of itself, develope alcohol and carbonic acid." The following is the substance of the succeeding observations by the same eminent enologue. "It is necessary to add two other substances to obtain the fermentation of sugar in water. One of these, containing azote, or nitrogen, resembles the animal substance albumen, or the white of an egg: the other is of the nature of starch. All fruits and substances such as malt, which readily undergo fermentation, contain these matters in greater or less quantity. Under the action of the air, they enter into strange combination when mixed with a solution of sugar, by which there is produced, the ferment, a substance so nearly of an organized nature as to be said to be almost living. During the fermentation, the formation of this ferment goes on with much greater rapidity than the formation of alcohol, and the result, in most cases, is an excess of ferment, or yeast, after all the sugar has been converted into spirit. In the case of malt wort, the quantity of ferment is excessive; according to Leiberg, thirty times more than is required to complete the conversion of the sugar into spirit."

According to M. M. Quevenne and Mitscherlich, the ferment if examined with the microscope, present the appearance of globules, like those of the blood of animals; these are cells of an elongated form, having an envelope whose composition resembles starch, while the contained liquid is similar to albumen or the white of egg, as already mentioned. Both these chemists are disposed to consider these globules as really organic.

Animal substances of similar composition to albumen, and which readily become putrid,—such as glue, isinglass, curd, &c.—have the power of becoming ferment, though slowly, when exposed for a few days to a temperature of 80° or 90° Fahr. But of all substances convertible into ferment or yeast, vegetable gluten and albumen, which exist in fruits, more especially the grape, possess the most rapid and energetic powers. When exposed to the action of the air, at the crushing of the grapes, these principles begin to undergo that change in their chemical constitution which forms them into ferment; without this action of the air, or its oxygen, upon the grape juice, their principles remain inert. As long as the grape juice is confined within the grape husk no fermentation takes place, and Guy Lussac shewed, that when expressed in a vacuum, or where oxygen is entirely excluded, the necessary changes for the conversion of these principles into ferment do not happen; but he also showed that the process once begun, by allowing the access of oxygen, needs no further action of the air, but will go on, slowly, in vacuo. Such is the nature and origin of ferment, according to the chemists, but they fail in attempting to give any explanation of the manner in which that singular conversion of the sugar into alcohol and carbonic acid is effected.

"In what way the action of the yeast particles upon the saccharine substance is carried on in the vinous fermentation, or what may be the interior working of the

process is not accurately understood. The quantitive relation of the carbonic acid and alcohol to the sugar is pretty well made out, but the determination of the ultimate principles of the ferment itself, before and after the vinous change, and of the residuum dissolved in the fermented liquor, has not been well ascertained. It is probable that the yeast undergoes in the process a similar decomposition to the putrificate, and that its elementary constituents enter into new combinations, and abstract so much carbon and hydrogen from the sugar, that the remainder, amounting to 96 per cent. of the whole, may constitute one atom of alcohol and one of carbonic acid."

Although our knowledge of the intimate nature of fermentation is confessedly unsatisfactory, we shall find it otherwise with an enquiry into the circumstances which modify the process. The various causes which promote and accelerate fermentation on the one hand, and those which retard and impede it on the other, are well understood; and it is unnecessary to point out the advantage the wine maker must derive from a knowledge of them.

The circumstances which promote, and are in fact necessary to the vinous fermentation, are the following: *—1, The presence of the proper quantity of yeast, or ferment, and its proper distribution through the worts, or matter to be fermented. If in the progress of a slack fermentation, the yeast subsides to the bottom, the intestine movements cease entirely; but they may be excited anew by stirring up the ingredients, or rousing the tun, as the brewers term it. 2. A certain degree of warmth, which should never be less than 51° Fahr., nor more than 86°. A temperature of from 68° to 77° is the most propitious for the commencement and progress of fermentation. When other circumstances are the same, the rapidity of the fermentation is proportional to the temperature within certain limits; so that by lowering it, the action may be moderated at pleasure. 3. The fermentation proceeds better and more equally, the greater the mass of the fermenting liquor, probably on account of the uniformly high temperature, as well as the uniform distribution of the active particles of the yeast by the greater energy of the intestine movements. The influence of temperature, as here stated, refers of course to cold countries. In warm climates, where the temperature is inconveniently high, it is necessary to keep down the heat of the fermenting liquor, and to this end smaller vats are required. 4. The saccharine solution must be sufficiently diluted with water; when too much concentrated it will not ferment; hence very sweet musts furnish wines containing much undecomposed sugar. For a complete fermentative action, one part of sugar should be dissolved in ten parts of water.

On the other hand, fermentation may be tempered or stopped, by too high or too low a temperature, beyond the limits already pointed out. When the heat rises above 86°, it is first impeded, and by a further rise it is stopped entirely. Boiling for ten minutes renders yeast quite inoperative. When the temperature falls below 50°, the same retardation and final stoppage takes place in the fermentation. In the second place, fermentation may be tempered by the essential oils, particularly those which contain sulphur. And thirdly, the

fermentation can be checked in a great measure, but only for a time, by sulphurous acid. This is one of the most useful agents for rendering inert the ferment, and is of great service to the wine maker. Sulphurous acid is produced simply by burning sulphur in the air; during the combustion the sulphur unites with the oxygen of the atmosphere, in the proportion of equal weights of sulphur and oxygen; or, according to the scale of chemical equivalents, two of oxygen to one of sulphur. This acid diffuses itself rapidly through the air, and is made unpleasantly familiar to our senses, in its effects on the eyes and nose, when a sulphur match is burned. The action of sulphurous acid is thus described by Maumene: "This acid presents the remarkable property of arresting fermentation in two distinct ways. In the first place it is very greedy of oxygen, and takes to itself all it can find in wine, in the lees, and all liquid and semi-liquid matters. It stops fermentation by the exhaustion of the oxygen necessary to the production of ferment. In the second place, by this same absorption of oxygen, it produces sulphuric acid, whose concentration is very great at the instant it is formed, and gives it power to destroy, in part, the greater number of the organic substances capable of inducing fermentation. The two actions go on together, and the sulphurous acid may be regarded as one of the best preservatives against fermentation." This important agent we shall find of infinite importance in the cellar, and shall return to it under that head. The last, and perhaps to us, most important agent in controlling and stopping vinous fermentation is alcohol. It matters not whether it be formed by the fermentation, or given to it as spirit; when the quantity becomes excessive, the ferment is rendered inert, and falls to the bottom. "When sugar and ferment are present in sufficient quantities, it is not possible, by means of fermentation, to produce an alcoholic liquid of any strength that may be wished. When a certain amount of alcohol has been produced, the future activity of the ferment is hindered by it, even when an excess of sugar is still present. This is the case with wines which contain more than 20 per cent., by volume of pure or absolute alcohol—that is to say, when the liquid has become too rich in alcohol, so that the fermenting matters coagulate, and become insoluble, and therefore inert. Experience teaches us, therefore, that if the amount of alcohol has, during fermentation, fully reached 20 per cent. by volume; this may be considered as a maximum, after which fermentation is impossible. All sugar which is still left remains undecomposed, since the ferment has lost the power of exciting fermentation in the strong alcoholic liquid."

This quantity of alcohol, 20 per cent., indicates a strength at which few wines arrive by simple fermentation. According to the best authorities—Brand, Christison, and others—port wine contains from 19 to 23 per cent. of alcohol, by volume; sherry, from 19 to 21; and Madeira, from 17 to 23. All these wines we know have a large per centage of spirit added to them, probably 10 per cent. of proof spirit, or more for the strongest; and if we deduct this, which is equal to 5 per cent., of alcohol from the above, we shall have 18 per cent. as the amount of alcohol formed during fermentation in the strongest; and this is so far confirmed by the fact that Amontillado Sherry, a wine to which no spirit has been added, contains, according to Christison, 17 per cent. of alcohol. While the fermentation is going on in strong must, or wort, we find it gradually become more languid, as the alcohol becomes more abundant, and very often it will cease altogether, long

before the alcohol formed reaches the maximum assigned by Mulder. This may happen from various causes, "but chiefly from the presence of acids, and the tartrate and malate of potass, when in excess." "If, for instance," continues the same, "the grape juice contains too much cream of tartar, (super-tartrate of potass) this will hinder fermentation by rendering a portion of albuminous matter inert, and thus causing some of the sugar to remain undecomposed. A certain quantity of acid, or supersalts, is ofuse; too much is injurious."

In the fermentation of strong ale, the malt wort, which contains sugar, and all the elements required to form ferment, and is therefore analagous to grape juice, goes on fermenting readily at first, but as the spirit formed becomes considerable, the fermentation goes on languidly, and would cease prematurely, if the yeast were not stirred up frequently. No such stirring of the yeast is required in the fermenting of small beer; the little sugar which its wort contains, is soon fermented, and then the chief object is to get rid, as quickly as possible, of the remaining ferment, which, if left in the beer will bring about the next change, so much to be dreaded in weak spirituous liquors, the acetous or vinegar fermentation

The difficulty of pushing the fermentation of strong ale to the extent required, arises not solely from the quantity of alcohol generated, for this does not exceed, in the strongest ale, 7% per cent., nor can it be for want of ferment, since there is always a large surplus of fresh yeast when the fermentation ceases. The chief controlling influence on the fermentation of ale and porter is the essential oil of the hop. This serves a most useful purpose in malt liquors, independent of the flavour it communicates. The sugar or saccharine matter in ale is never thoroughly fermented out or attenuated; care is taken to retain a considerable portion unchanged, by withdrawing the yeast before the process is completed. Under the influence of the hop, the saccharine matter is kept in a state of slow fermentation, and an evolution of carbonic acid is maintained, which is essential to the constitution of all beers and porters. The preservative power of carbonic acid is familiar to all, in its effects on malt liquors; as long as these remain effervescent, there is little danger of their spoiling, but they no sooner lose this quality, and become flat, than they begin to undergo acetification and putrefaction. The distiller, whose chief care is the conversion of the whole of the fermentible matter into spirit, makes his worts very weak to insure this, as weak in fact as the law allows him. The minimum allowed in England by the Excise laws is a specific gravity of 1050; while Scotland and Ireland are privileged to mix their worts for distillation as low as 1030.

In fermenting grape juice for distillation, the wine- maker will take the same precaution to insure the complete attenuation, or conversion of the saccharine matter of the must into alcohol, by reducing the specific gravity with water to 1060, or even lower. Like the distiller, he also watches, with the utmost vigilance, the moment of the full attenuation of the must, knowing full well the tendency of the resulting weak liquor to run into the acetous state, by which part of the spirit is converted into vinegar, and consequently lost.

The same variety in the quality or saccharine richness of the worts of ales, beers, and distillers' worts, will be found in the must or juice of the grape, according to climate, soil, and variety of vine. Indeed it may be said that the difference between the poorest and the richest musts is greater than that between the small wort of distiller, or small beer, and the strongest Burton ale.

The following table shows the relative richness in saccharine matters of the wort of malt liquors, and the must of grapes, and also the difference in the attenuation to which they reach. And this also leads us to consider the means by which the saccharine quality is ascertained, and the subsequent attenuation correctly indicated.

FRENCH WINES, according to SCHUBLER:

Specific gravity of Must. Quality of Must. Sp. gr. of Wine.

1050 Watery and poor...

1060 Light and middling...

1070 Good, better than middling...

1080 Very good, that of the Table Wines of France and Germany...

1090 Excellent, the best wines of the Neckar and Rhine...

1100 Superior, the good wines of the centre of France...

1110 Very rich, wines of the South of France and Spain...

SPANISH WINES, from M.S. by CoRMAcK:

1150 Moscatel sweet wine...

CHAPTER VIII.

FERMENTATION CONTINUED.

WITHOUT the means of ascertaining accurately the quantity of saccharine matter in wort, the progress made in the conversion of this sugar into spirit, and finally the attenuation to which it arrives, neither the brewer nor the distiller could carry on their operations with satisfaction or profit. The wine maker, in like manner, ought to possess the means of finding the quantity of saccharine matter in the grape juice which is to undergo fermentation. Different varieties of vine, and

even the same vine, in diversities of soil and climate, yield a juice of very various quality as to saccharine richness, of which the taste can give no indication, since it is completely marked by the free acids contained in the juice. The action of the saccharometer, the instrument used to ascertain the quantity of saccharine matter in any liquid, is based upon the circumstance that the relative weight of liquids containing sugar in solution increases in proportion to the quantity of sugar in each. If we weigh accurately the contents of a vessel, about a pint or so, filled with pure water, and note the weight; and then fill the same vessel with a solution of sugar of good quality, of the proportion of one pound in a gallon of water, and weigh it also, we shall find their weights will bear to each other the following relations. If we call water 1, the solution of sugar will be 1.04; or their relative weights may be thus variously stated,

Water 1. Solution of Sugar 1.04

10. 10.4

100. 104

1000. 1040

These numbers 1.04, 10.4, 104, and 1040, express the specific gravity of the solution, or its weight in relation to water as the standard. And it matters not which of these bases we take for water. If the figures are read off individually, there can be no misconception as to the base or standard. Chemists and others generally make the standard- water, 100; and they would read the sp. gr. of the solution, 104. Were this universally done there could be no misconception; but unfortunately, the brewers, distillers, and the Government have made the standard 1000; and to save the trouble and inconvenience of the long number, they merely state the number over the thousand. Thus, instead of calling the sp. gr. of the solution one thousand and forty, (1040) they call it gravity forty. Now, if the chemist who uses the standard of 100, were to tell a brewer that the specific gravity of a fluid was 104, the brewer would take it to be 104 over the thousand, or 1104. To obviate all such difficulties, the individual figures ought to be enumerated. If stated thus- one, nought, four, there could be no misconception of the meaning, and it would not matter what the standard was called, whether one, ten, a hundred, or a thousand. A specific gravity of 112 would be read one, one, two, and if the division were more minute, giving the thousandth parts, such as 1135, it would still be read in the same way, one, one, three, five.

The mode of ascertaining the relative weight or specific gravity of fluids, by weighing a given bulk by means of a common balance, is both clumsy and

inconvenient. The instrument used by brewers and others for the purpose, is a float, constructed generally of glass, having a graduated scale, showing the relative weights. When this instrument is put into pure water, the number 100 is level with the surface of the water. When placed in a solution of sugar in water, it stands higher; the numbers on the scale indicating the relative weight of the solution to water, or the relative proportion of sugar in solutions of various strength. The scale goes to 120, or one-fifth heavier than water, which is above the gravity reached by grape juice. There is also provision made to indicate the attenuation by carrying the scale below water, to 98.

The only other scale indicating specific gravities, is that called Thomson's, in Britain, and which is used, as stated, by the Government Excise in Britain, as well as distillers, and by enologues in France. The numbers, on this scale, express the weight over 1000, as already mentioned.

There is also a scale much used in France, to which reference is often made in works on wine making: this is Beaumé's, an arbitrary scale, which is constructed on the two standards of water, and a saturated solution of sugar. This last is called 60°, and the interval between it and water is divided into sixty equal parts. There are numerous other arbitrary scales, which tend to cause confusion, all of which ought to be discarded as worse than useless. The only other scale we need mention, is the brewers, which shows the pounds weight of malt in a barrel of wort. Although this scale assumes a fixed quantity of saccharine matter in all malt—which is erroneous—it is practically correct so far as the information required by the brewer is concerned.

The following table of the relative numbers on Beaumé's scale, and the specific gravities, is given in Maison rustique, and may be of service to those who already possess that instrument:

Degrees Beaumé. Specific gravities. Degrees Beaumé. Specific gravities.

1 1008 13 1099

2 1014 14 1107

3 1022 15 1116

4 1029 16 1125

5 1036 17 1134

6 1043 18 1143

7 1051 19 1152

8 1059 20 1161

9 1067 21 1170

10 1075 22 1180

11 1083 23 1190

12 1091 24 1200

An inspection of the table of specific gravities shows great diversity in the quality of grape juice, and points out the impossibility of laying down definite rules as to the mode of conducting the fermentation in all cases. The difference between the weakest and the strongest wines is as great as between the strongest ales and distillers' liquor; and as there is a great difference in the manner of fermenting malt wort according to its saccharine strength, so is it also with the juice of the grape. The diversity in the case of the grape juice, however, is not in the relative quantity of the saccharine matter alone; the other constituents of the grape vary constantly in their relative proportions, and affect the fermentation to a great extent.

Modern chemists have given a very minute analysis of grape juice, and shown that besides sugar, and the albumenous matter which yields the ferment, it contains potass, soda, lime, and alumina, variously combined with acids, both vegetable and mineral,—sulphuric, muriatic, phosphoric, tartaric, malic, citric, and tannic. Besides these there are minute portions of other substances, which are of little import to the practical wine grower. To those who would pursue the study of this subject, I would recommend the perusal of Mulder's Chemistry of Wine, or the work of M. Maumené.* Of all these matters the most important by far are the tartaric acid and potass. These combined form the supersalt, supertartrate of potass, or cream of tartar, or simply tartar, which may be called the great controlling agent in true vinous fermentation. The tannic acid, or tannin, the astringent bitter principle, and the colouring matter of the black grapes, also require notice. The properties of Tartar, which plays so important a part in wine making, are thus described by Maumené:—"The salt which is met with in all wines, (with the exception, perhaps, of very old wines) is the supertartrate of Potass or Tartar. This salt is of great importance; possessing a decided acid taste, it communicates acidity to wine, and contributes to give it its special taste. One of the principal variations of this taste comes directly from the changes in the proportion which the tartar undergoes during the natural development of the wine. Thus, wine recently made contains in solution a large quantity of tartar; the weaker the wine, and the less alcohol it contains, the more of this salt exists in it. It is easily dissolved in pure water, a litre, (nearly a quart), of cold water takes up about 84 grains; boiling water, about ten times this quantity. On the other hand, tartar is quite insolluble in alcohol. Wine recently made, and in which all the sugar is not yet changed into alcohol, can contain 84 grains; I have on several occasions tasted it, and have found even more than this quantity, probably from the sugar and other matters increasing its solubility. In proportion as the wine becomes perfect, and the sugar ferments and is converted into alcohol, the tartar deposits itself, and may even entirely disappear; a circumstance which rarely happens, except in very old wines which abound in alcohol. The taste of the wine changes much by that elimination, and becomes more and more soft."

The tartar plays another very important part. To it is attributed the property of dissolving the ferment, a subject of moment in all wines, but more especially in the sparkling wines.

This salt is also endowed with a remarkable power of dissolving a number of substances difficult of solution, except by the most active acids. The metalic oxides especially, are dissolved by tartar with remarkable facility; hence the inexpediency of using metal utensils in drawing off wine from one cask to another, and the impossibility of using metallic vessels for keeping wine. Silver is an exception to this, and is the only metal at all fitted to make vessels for tasting or heating wine.

The power which tartar possesses of promoting fermentation, depends upon its composition as a super- salt; that is, a salt in which the acid so greatly predominates over the alkali as to possess much of the powers of a free acid.

Unripe grapes contain a considerable portion of malic acid—the acid of apples, and it is this acid, which, acting on the ferment, causes their rapid fermentation. "As the grapes ripen, this acid would appear to diminish in quantity, and perhaps altogether disappear. In the ripe grape we found the tartaric acid." The importance of tartar in developing the most valued qualities of wine, is thus stated by Leibig. "The substances in wine to which its taste and smell are owing, are generated during the fermentation of such grapes as contain a certain quantity of tartaric acid;" (query—combined with potass?) "they are not found in wines free from all acid, or which contain a different organic acid, such as the acetic." "The wines of warm climates possess no odour. Wines grown in France have it in a marked degree; but in the wines from the Rhine, the perfume is most intense. The kinds of grapes on the Rhine which ripen very late, and scarcely ever completely, such as the Riessling and Orleans, have the strongest perfume or bouquet, and contain proportionally a large quantity of tartaric acid. The wines from the earlier grapes, such as the Rulander, and others, contain a large proportion of alcohol, and are similar to Spanish wines in flavour, but have no bouquet. The grapes grown at the Cape, from Riesslings, transplanted from the Rhine, produce an excellent wine, which does not, however, possess the aroma peculiar to Rhenish wines. It is evident from these facts, that the acid of wines, and their characteristic perfumes, have some connection, for they are always found together; and it can scarcely be doubted that the presence of the former exercises a certain influence on the formation of the latter."*

This opinion of Baron Leibig, regarding the excellency of Rhenish wines, cannot be gainsaid, so far as their peculiar qualities are concerned, but there is here a tendency to undervalue other wines, whose nature and qualities are entirely different from the weak Rhenish, and which, on that account, cannot be put in juxta position. How is it possible to compare Madeira with Johannesburg, or

Amontillado with Hochheimer? And yet, these are equally excellent wines, and would, probably, be more generally appreciated than the weak wines of the Rhine.

The next important constituent of the grape which comes under our notice is the tannin or tannic acid. According to Mulder, "Not the slightest trace of tannic acid is to be found in the juice of either purple or white grape. When tannic acid is discovered in white wine, it proceeds from the skins, a larger or smaller portion of which were included in the fermentation; and the same holds good with regard to red wine, for no more tannic acid can be detected in the juice of the purple than in that of the white grape." "There is a larger quantity of tannin in the skins of purple than of white grapes,—and as all red wines are prepared by fermenting the skins in the must, in order to obtain the colouring matter, which exists also in the skins, the quantity of tannin in red wines is always great, and constitutes one of the peculiarities which distinguishes them from the white." The seeds also contain a portion of tannin, but of this, unless bruised, they communicate little to the wine.

Tannic acid, better known as tannin, is the bitter astringent principle which exists in the bark of many trees, and other vegetable matters, and which forms an insoluble compound with animal jelly or gelatine. Common leather is the product of the union of the tannin of bark, generally of the oak, with the gelatine or glue of the hide. Tannin also combines and forms insoluble compounds with the albumen of grape juice. A certain quantity of this astringent principle is generally considered essential to a sound wine, as it tends to improve its keeping quality.

" Tannic acid possesses a harsh taste, and in excess has an injurious effect on the digestive organs. There must be a little in the must, especially in that of wines rich in albuminous principles, in order to precipitate them, and not leave after the alcoholic fermentation, a substance capable of producing another fermentation, which would always be dangerous. The necessary quantity can, in general, be furnished by the skins and seeds, which contain it and yield it readily. In some cases these do not furnish enough, and that of the grape stalks then becomes necessary."

The means by which we may ascertain whether or not the grape stalks may or may not be required in any case, are simple enough: If we take a bottle of the wine in question, after finishing its fermentation, and find that it gives a sensible precipitate, when a little tannin, or infusion of grape stalks is added to it, it needs the tannin; but if no precipitate forms, the stalk ought to be taken out, for it can only give bitterness and injure the wine.

The only other principle which we have to consider, the colouring matter, really does not exist in the grape juice itself, it is furnished by the skin. The juice of

black or purple grapes, if expressed with care, and fermented without the skins, produces a white wine. There is one remarkable exception to this, in the Tinto grape, whose juice is dark red. The colouring matter of dark grapes is said to be more fully developed by keeping them exposed to the air some time after gathering; a proceeding now much recommended, in cases when from lateness of the season or other cause, the colouring matter is deficient,

Having briefly considered the chief constituents of grape juice, we find nothing in its composition to cause any great difference in its mode of fermentation from that of malt wort, except, perhaps, the presence of free acid, or rather acid salt—the supertartrate of potass—in the must. This salt promotes the fermentation, if not in excess, and causes the development of all the qualities for which wine is valued. In the making of wines from common garden fruits, as for instance the gooseberry or currant, the addition of tartar has the effect of assimilating the resulting wine to that made from the grape. The addition of tartar also hastens the fermentation of malt wort.

The same general principles apply to the vinous or alcoholic fermentation, under all circumstances. The same causes which accelerate and retard fermentation, in solutions of sugar and malt wort, have a similar effect on the juice of the grape. A weak must, like weak wort, goes rapidly through its fermentation, thoroughly attenuates itself, and if great care be not taken at this stage, it will run into the acetous fermentation, and very soon become vinegar. Strong must, on the contrary, like rich wort, ferments more slowly, and is apt to stop short before all the sugar is fermented. Too high or too low a temperature checks fermentation; but the temperature which grape juice may attain, without injurious effects, is probably considerably higher than that to which malt wort could, with safety, be allowed to rise. In cold climates, where the vintage is late, the chief care is to keep up a sufficiently high temperature in the must to commence the fermentation, and afterwards to maintain it during the process. In the warmer parts of Australia the vintage begins sometimes in February, and is generally over in March; a season, when the weather is occasionally very hot. It is by no means an uncommon occurrence for the temperature to remain for some days above 90° during the day, and never under 80° at night. Must, fermenting under such heat, rises many degrees above the highest temperature of the air—ten degrees probably. The effect of this high temperature is by no means so injurious as might have been anticipated. Much good wine has been made whose temperature during fermentation has risen to 100°. The temperature of 86° is the limit, beyond which a sound healthy fermentation cannot be maintained in beer and other worts; and such was thought to be the case also with grape must; the opinions of modern œnologues, however, have undergone a change on this subject. * * An acquaintance with many details of which we are still ignorant, is however, necessary, in order to investigate thoroughly the influence of temperature upon a well tasted wine, which should not spoil with age. The grapes of each country, ripened under different degrees of summer warmth, and very unequally rich in constituents, require different temperatures during fermentation; and different temperatures are required for grapes which are the product of a warmer or colder summer. But we are still ignorant on these points.

All we know is, that a high temperature during autumn, promotes fermentation, and a low one is detrimental to it; that inequality of temperature during fermentation is extremely injurious, and not unfrequently spoils the wine altogether." Baron Liebig, in writing to the late Mr. King, on the wines of New South Wales, says: "As the wine of Irrawang contains an ample quantity of saccharine matter, I deem it expedient that you should allow it to ferment at the highest possible temperature."

The illustrious chemist, however, would surely set some limit to the temperature. One thing is certain, that it is only very strong must which can be allowed to rise so high as it does with us in Australia. The weak must of the north of France and the Rhine, whose specific gravity may be about 106, would pass into vinegar were it exposed to a temperature of 90 and upwards.

In colder countries large vats are employed as best suited to maintain the temperature of the fermenting mass; but they would be objectionable where it is desirable to keep the vats cool. How to keep down the temperature of the fermenting must, is the most difficult problem the Australian wine grower has to solve. "Experience has taught us that the temperature of fermenting wine cannot be kept down by the use of underground cellars, unless the quantity be insignificant. We prefer a wooden building above ground, with the means of admitting free currents of air on all sides. Any accession of heat which a hot day may occasion, is more than compensated for by the cool night air, which has free admission on all sides. A large body of wine will rapidly heat an underground cellar, and it cannot be cooled down again for many days."*

A free admission of air to the surface of the fermenting liquor, has the effect of keeping down the temperature. To this we shall revert shortly. Where it is desirable to exclude the air, as in the fermentation of red wines, some other means are required to prevent the fermenting liquor from rising to an excessive heat, as it must do under a temperature of the air of 90° or upwards. This may be effected by means of a refrigerator, represented in the accompanying engraving.

It will require no particular explanation. It is simply a pipe formed like the worm of a still, through which the cold water from a cistern flows, and is discharged again outside. The entrance and exit parts of the pipe are placed close together in order to interfere as little as possible with the fixing of a false lid, and also to facilitate the strengthening it by a frame. By means of a long flexible tube, to fit on by a coupling-screw, the apparatus may be applied to a vat at a distance from the cistern. The supply of water for the cistern, must of course, be from a well or underground tank, whose temperature is moderate; and care must be taken that it does not lower the temperature too much. This refrigerator has been used with excellent effect in this colony, but was given up from a dread, perhaps a needless one, of the effect of the metal, block tin, upon the wine. The same apparatus is used during warm weather in some breweries in Britain, where

great care is employed in conducting the fermentation, and where it is essential to maintain a steady temperature. When the temperature is low the same may be used to keep up sufficient heat in the liquid by passing hot water through it.

The chief objection that can be brought against this refrigerator is, the material of which it is constructed. The powerful action of the tartar upon metals, already alluded to, forbids the employment of any metallic implements which are to come in contact with grape juice. Silver is the only metal which is not much acted on by tartar; and a copper tube, electro-plated at that part which is immersed in the fermenting must, would, probably, be not too expensive to forbid its use. An iron or copper tube enamelled, would also be an excellent material for the purpose. Glass might be employed for the construction of refrigerators; it could be protected by a wooden frame; and as it is only the portion immersed which is effected by the tartar, the entrance and exit pipes may be constructed of metal. The only objection to glass is, its slow conducting power, but this may be so far obviated by giving it a larger surface.

It is surprising to find so little attention paid to temperature in the fermentation of wine in these colonies. If the general principles of fermentation are of universal application, we have no reason to treat grape juice as if it were an exception, and expect that it can be fermented successfully when we disregard the conditions under which alone a healthy fermentation can be conducted. Grape juice certainly ferment more readily and completely than any other fermentable substance, and has, perhaps, less tendency to go into the acetous state; and wine makers, trusting too much to its power to resist the deteriorating influences to which it is often exposed, do not consider it necessary to abide by the laws which regulate the fermentation of other substances, but take extreme liberties with the grape must. For example, the temperature of the fermenting must may rise to 100°, and sometimes several degrees above it, and the resulting wine may be sound and good. The conclusion drawn from this is, that wine may be fermented at a very high temperature without injury. Not without injury, certainly, as the following experiment shows. A quantity of purple grapes was crushed during very hot weather, the temperature of the air being above 90° during the day, and never under 80° at night. The must and skins were put into a vat of 250 gallons, and a false lid placed as usual to keep down the mark. There was more than sufficient to fill the vat to the proper height, and the remainder, about forty gallons, was put into a small vat, (a port wine pipe having the head out), a false lid was also fitted into this. The fermentation commenced in each the following day, and in two days the temperature rose considerably during the tumultuous fermentation, but that of the larger vat was at least eight degrees higher than the temperature of the smaller. After this, the progress of the attenuation showed a marked difference in the two vats. In the smaller, it went on steadily, and in three days after the height of the fermentation, it had fully attenuated itself, giving a specific gravity of 100, and was racked off clear and in fine condition; whereas, the larger vat attenuated very slowly. On the third day after the violent fermentation, its specific gravity was still 102.5; the following day it had come down very little, showing 102, and was full of yeasty matter floating through it. It was racked off into casks to undergo the secondary

fermentation; and although eventually it attenuated after some time, it was an inferior wine to that drawn from the smaller vat.

It has been often remarked that the first experiments in wine making are generally the most successful, but it is easy to divine the reason of this. The first quantities made are generally very small, 40 or 50 gallons, or less; the temperature of so small a body of fermenting liquor seldom rises high, and the process goes on under much more favourable circumstances in this respect, than in the subsequent vintages, when the fermentation is generally conducted in quantities of from one to several hundred gallons, when the increase of temperature is necessarily greater.

The fermentation of grape juice is so entirely a natural process, and goes through its course so perfectly, under favourable circumstances, that we are apt to become careless, and say that we are trusting the process to nature, when in fact we are counteracting her operations, and going in direct opposition to the conditions under which fermentation can proceed with success. There certainly exists in the grape a vital energy, a sort of vis medicatrix, which not only resists many evil influences to which it is exposed, but seems also able to correct them when they have occurred.

To none of the conditions necessary to a sound healthy fermentation ought we to pay more attention than temperature; and there is, probably, none so much neglected. This arises, doubtless, from the difficulty, and I may say, the supposed impossibility of counteracting the excessive heat of the climate. The construction of an apparatus for keeping down the temperature, of the nature and form already alluded to, would be neither difficult nor costly, and of its beneficial influence on the fermenting process, and the resulting wine, there can be little doubt; for the great majority of our wines are fermented at too high a temperature. When we find writers, such as Liebig and Mulder, recommend a high temperature for the fermentation of the wines of warm climates, we solace ourselves with the idea that we are on the safe side in this respect; forgetting that what these writers would consider a high temperature, is probably, 86°, the highest point assigned to a healthy fermentation; but supposing that they allow a higher limit—say ten degrees above it; still this is far below what the fermenting vats of these colonies often attain, for in many cases they must rise ten degrees higher still, to 106; or 20° above the limit already indicated as that beyond which the fermentation does not go on favourably. This is a temperature surely never contemplated by any of these writers, and which no must ought ever to be allowed to attain.

The effect of a very tumultuous fermentation in beer, caused by a high temperature, is thus described by Dr. Ure*: "When the action is too violent, these barmy glutinous matters get comminuted and dispersed through the liquor, and can never afterwards be thoroughly separated A portion of the same feculent matter becomes, moreover, permanently dissolved during this furious

commotion by the alcohol that is generated. Thus beer loses not merely its agreeable flavour and limpidity, but is apt to spoil from the slightest causes. The slower, more regularly progressive, and less interrupted, therefore, the fermentation is, so much better will the product be." If such are the results of a too violent fermentation in beer, we cannot doubt that it must also have an injurious effect on wine.

The grapes of the warm districts of these colonies, which attain a sp. gr. of 112, or more, are able to bear, and probably require, a very high temperature to complete their fermentation; the exact limit we cannot define, but we may venture to say that 95° is a temperature beyond which it would not be advisable to allow any wine to rise, and probably 90° is the highest it ought ever to attain.

There are terms in constant use with regard to wines, such as light, warm, sweet, dry- - terms which imply a certain classification, but are too indefinite in their meaning to be of any practical utility. In order to remove all vagueness and uncertainty as to their signification, we shall endeavour to give them a sufficiently definite meaning, and make them the basis of classification. This classing of wines, which we shall attempt, according to their relative alcoholic strength, or what is the same thing, the relative quantity of saccharine matter in their musts, may be objected to as arbitrary; but the same objection might be brought against all such arrangements, and this, which is the most practical, may be found useful as we follow up the subject on which we are now engaged.

According to their strength, wines may be divided into three classes- - light wines, warm wines, and liqueur wines; and the limits of each class may be defined by the richness in saccharine matter of their musts. The light wines are those of the north of France and Germany; the warm are the richer wines of the south of France and Spain, and the countries about the Mediterranean; while the liqueur wines are those so rich in saccharine principle, either from natural ripening or artificial concentration of the juice, as to be unable to convert all their sugar into alcohol, the excess remaining undecomposed, and giving the luscious sweetness for which these wines are valued.

The light wines of France seldom have the specific gravity of their musts above 108, and such we may fix as their maximum; all above this may be regarded as warm wines. The term warm applies well to such wines in contradistinction to the cooling and ethereal flavour or bouquet of the genuine light Rhenish wines. This bouquet, which is the sine qua non of such wines, seems to be recognised only by the back part of the mouth, or fauces. When applied to the tongue, as in sipping, such wines are most unpalatable; they are, therefore, drunk from vessels with a slightly inverted rim, to prevent their coming in contact with the anterior part of the tongue and palate. On the same principle, porter is drunk from a deep pewter pot; the virtues of which are to be ascribed more to its form than any quality in the metal.

The warm wines are generally destitute of this bouquet, but have a warm spicy flavour and aroma, for which the French use the term sive. "This word sive is generally employed at Bordeaux, and in many wine districts, to indicate the vinous strength and aromatic savour which are developed to the taste, embalm the mouth, and continue to make themselves felt after the passage of the liquor. It is composed of alcohol and aromatic particles which are diluted into vapour the moment that the wine comes into contact with the warmth of the mouth and stomach; the same quality is also designated by the name of spirituous aroma. The sive differs from bouquet in this, that the latter is disengaged at the instant when the wine is exposed to the air; that it gives no indication of the presence of alcohol, and that it soothes the smell rather than the taste."*

Warm wines often retain a small portion of saccharine matter undecomposed, which, although insufficient to constitute them sweet wines, gives a certain degree of body or fullness; in many cases this is so small as to be inappreciable by the palate—the wine is then called a dry wine.

On the subject of wines enriched by concentration of their must, M. Mulder thus expresses himself:—"When the grapes are allowed to dry on the vines, the wine is called vin sec, dry wine." This is certainly not the accepted meaning of the term dry. In Britain and France those wines are said to be dry whose saccharine matter has been so thoroughly fermented out as to leave no trace of sweetness to the palate. Amontillado sherry is an example of this. All the light wines are essentially dry; the term is never applied to them, but is employed to distinguish those warm wines whose fermentation has been complete from those of their class which retain more or less sweetness.

When the specific gravity of must exceeds 112, the fermentation is seldom so complete as to convert all the saccharine matter into spirit during the first fermentation; but under favouring circumstances, the succeeding, or silent fermentation in the cask, may do so, and produce a wine more or less dry. Much, however, depends upon the peculiarities of the grape, and other circumstances to be noticed shortly. When the sp. gr. exceeds 114, the excess of unfermented sugar in the wine is so great that it is decidedly sweet, and is termed a liqueur wine. The sp. gr. of the must from which such wines are made is generally much above that stated; the sweet wines of Spain are made from must whose sp. gr. ranges from 114·3 to 117·0. The danger which the unfermented sugar in these wines runs of undergoing acetous degeneration is so great, that a large portion of spirit is generally added to them to guard against this evil.

We may anticipate objections to those limits in our classification, since people must differ as to what are light and what are warm wines. The Port wine drinker regards the wines of the south of France, Barsac, Sauterne, as decidedly light

wines, while to the man accustomed to light Rhine wine, they are decidedly warm.

To this division, therefore, it will be expedient to add another or supplementary one, comprising the strongest of the light wines, and the weaker of the warm wines. These may be termed medium wines, and comprise those in the scale from 108 sp. gr. to 110 inclusive. The following is the tabulated classification proposed:

Light wines ... 105 106 107 108 109 Medium wines. 110 111 112 113 114 115 116 117

In the succeeding chapter, we shall follow up this subject with the more practical details connected with the vintage, and the attendant work in the fermenting house; noting first the preparations required to carry out the details.

CHAPTER IX.

PREPARATIONS FOR VINTAGE.

As the period of the vintage approaches the necessary preparations must be completed; and that nothing may be wanting when the proper time of gathering arrives, we shall enumerate the various articles and apparatus required in the cellar, and also for collecting and transporting the produce from the vineyard.

The cellar, or rather fermenting house, in which the first fermentation is to be carried on, ought to be a large airy building in a cool situation; the foot of a hill having a southerly aspect is, of course, the best in warm districts. The walls may be constructed of timber, stone, or cob, as is most convenient; and if the ground slopes, the floor must be cut down to the lowest level, where the chief entrance is.

Let us suppose accommodation required for a vineyard of ten or fifteen acres: 40 feet in length by 20 or 24 in width will afford ample space. The walls may be ten feet in height. From the breadth of the building, the span and height of the roof will be considerable, and will conduce to the coolness of the interior. Thatch is the coolest roof, but is objected to as harbouring mice; but a wine cellar affords little temptation in the way of food, and it will be found that the inconvenience from such vermin is not great.

If shingle, either of stringy or iron bark, is used, it ought to be as thick as possible, to exclude the heat. Large windows on either side, provided with shutters and sunlights, or venetians, exclude the light and radiated heat during the day, while they admit the cool air at night. The roof, if carried out 10 feet all round the building, will add much to the coolness of the interior during the day, by protecting the walls from the sun; and, at the same time, will form a verandah, which will be found of service for cooling the grapes gathered in hot weather.

A building of this size will be sufficient, not only for fermenting, but also for storing during the first winter 2000 or 3000 gallons. Before the next spring, a proper cellar, capable of maintaining a pretty even temperature, ought to be provided.

As the open building will be found to vary exceedingly in its temperature, and become too hot in the summer, the only way to secure a sufficiently cool place for storing the wine is to form an underground cellar, whose temperature does not rise at any time above 80°.

It is now the general opinion in warm wine countries of Europe, as well as in these colonies, that cold underground cellars are not adapted for warm generous wines, and that such wines ripen better in warm, dry buildings aboveground. By warmth is meant a reasonably high temperature, say 70°, 75°; or even 80°; but when the heat rises to 90°, and even 95°, which it will do in the interior of a building such as that described above, during one of the very hot summers of South Australia, it must have an injurious effect on any, except, perhaps, a very old and strong wine.

After the fermenting house and cellar, the next provision that must be made for the coming vintage is a supply of vats, in which the grape juice is to undergo its first fermentation. This will involve so many details regarding the various appliances and their uses of the fermenting apparatus, that we must necessarily anticipate many subjects connected with the after vintage operations.

We have already, under the subject of fermentation, pointed out the unfitness of large vats for these colonies. In cold countries they are found eminently useful in maintaining a steady heat, without which the fermentation would cease. But this quality of keeping up the heat in the fermenting mass altogether unfits them for warm climates, where they cause the temperature to rise to an inconvenient height. There is another objection to large vats, the difficulty or impossibility of getting them filled in one day—a thing which is considered very desirable, and can hardly be done when the vat exceeds 600 or 800 gallons. Tun butts, set on end, with the heads taken out, answer well, and especially for the fermenting of red wines. These butts, whose capacity may be about 250 gallons, do not run off

more than 120 or 140 gallons of red wine; they cannot be filled within 15 inches of the edge, and a great space is occupied by the husks. Where white wines are fermented without the husk, they will run off considerably more. As the fermentation is over generally in five days, the same vats may be filled three times during the vintage, since the grapes, even of the same varieties, do not ripen all over the vineyard, owing to soil or aspect, at the same time. It will be necessary, therefore, to provide at least three tun butts as vats for every thousand gallons of wine. The space left at the top of the vat is to prevent the overflow during the tumultuous fermentation: an event to be dreaded, not on account of any loss of wine that may happen, for it is only part of the yeast that is lost, but for fear of the souring and putrescence of this yeast about the rim of the vat. The mere vicinity, much less the contact, with any acid or putrescent matter is most prejudicial to wine, and ought to be most sedulously avoided in its management in all stages.

The must of white grapes may be fermented alone without the skins and stalks; it may be fermented with the skins; or it may have skins, stalks, and all thrown into the vat. The skins and stalks furnish the tannin, or tannic acid, a certain quantity of which is considered desirable, as already mentioned in describing the properties of tannin. In fermenting red wine, the presence of the skins in the must is in every case considered necessary, since it is the skins alone which furnish the colour and astringency so essential to such wines. In some cases, as in the more delicate and light red wines, it may be advisable to draw off the wine from the vat before the fermentation is complete, and before the wine contracts too much astringency from the skin. This astringency, or roughness, which ought to be considerable in a warm, generous red wine, is quite incompatible with, and would, if in excess, be detrimental to the quality of a really delicate red wine. "In the manufacture of the best Burgundy and coloured Champagne, the skins remain in the liquid from two to three days; in that of the Medoc, six days; eight days in those prepared in the South of France, which are especially meant for the table (vin ordinaire); fourteen days is the longest time, and in this case the wine has a very dark colour."*

The majority of red wines in these colonies are so strong as to require all the colour and extractive matter they can obtain from the skins. They may, consequently, be allowed to ferment with their skins until the process is completed in the vat. Deeming the astringency of the skins not sufficient, some have added the stalks also- a very questionable proceeding. There may be cases in which the stalks may be of advantage to wines, both red and white; but when employed for this purpose, they ought to be brown, and nearly dry, like the stalks of raisins. When used in a green state, as the stalks of many of our vigorous purple varieties are, when the berries are thoroughly ripe, the green sap which they contain must be most prejudicial to the wine, and is likely to contribute that "spoiled pickled cabbage taste" of which some of our wines have been accused. The stalks of some of the earlier and more delicate varieties, such as the Verdot, Carminet, and Malbec, ripen and dry along with the ripening of the fruit; but these are the very varieties in which it is desirable to avoid contracting an overdose of tannin, and where the presence of the stalks would be

detrimental. Besides, in these sunny climes, the quantity of colouring matter and tannin in the grape skin is so much greater than in Europe, that it must be a rare circumstance to find a well-ripened black grape, on a fair soil, deficient in these qualities.

In fermenting red wines, or any wines in which the skins are left in the must, the vats must be provided with false lids to keep down the mark or solid part, and allow the extraction of all the colouring matter in the red wines, and of the tannin in the white. The construction of this lid, and the means by which it is retained in its place, are shown in the annexed figures. Figure 1 represents a longitudinal section of a vat when filled, and having the false lid in its place. This lid, Figure 3, is formed of strips of old oak staves of about an inch thick, and an inch and half in width, nailed to three cross pieces of double that width; there are intervals left of a quarter of an inch, to allow the gas to rise freely, and retain the skins and mark. It is cut into a circular form, of the diameter of the vat, eight inches above the bung, and afterwards divided down the middle, in order to allow it to go into the vat. To retain it in its place the cross piece C, Figure 2, is placed diagonally upon it, as seen in Figure 3, and it is kept immersed by the struts T T T, Figure 1, which press upon the ends of the cross piece; and these struts, in their turn, are kept down by the chocks K K K, nailed to the sides of the vat near the rim.

The fixing of the lid is done in the following manner: When the vat is filled to the proper height with the must and mark, a quantity of liquid is drawn off by the tap at the bottom of the vat. To prevent the husks from escaping with the must, a wicker work seize is placed inside behind the tap, or what answers equally well, a bundle of dry vine cuttings. A sufficient quantity is drawn off to bring down the surface about five or six inches. The lid is then placed on the surface of the liquid, and the cross diagonally upon it, care being taken that the ends of the cross are directly under the chocks K K K. The struts are then put in, and are retained in their places by the pressure of the liquid. When all is sufficiently secure, the liquid drawn off is returned to the vat, and covers the lid with several inches of must. The mark is now firmly kept down by the lid, and the whole of the must passing and re-passing through it during the violent fermentation, extracts from the skins all their colouring matter.

The surface of the fermenting liquor ought to be protected from the air, by a covering of cloth thrown over the vat, and kept in its place by a hoop. The carbonic acid gas is thus retained, and forms a covering which keeps off the air, and prevents the acetification which is apt to occur from the contact of oxygen with the husks, some of which find their way through the lid, in spite of all precautions. This danger is much greater in red than in white wines; indeed, under no circumstances ought red wines to be exposed to the contact of the air. Red wines ferment more readily and more thoroughly than white, and do not require the action of the air to perfect their fermentation, as many white wines do. It is, therefore, a needless risk to expose them.

What can be said of the custom of throwing the whole of the mark, stalks and skins, into the vat, and allowing them to float on the surface, and often level with the rim, and having the air blowing freely upon them? It is only required to approach within a few yards of the vat, while undergoing fermentation, to know that there are often offensive processes going on besides alcoholic fermentation. The sour, mouldy, tan-yard smell, is an indication of the evil at work; and it is impossible that the wine can have escaped contracting a taint from the putrescent mass on its surface. In a warm, generous wine, such a taint may be disguised to the palate; but there is the leaven, which, under favouring circumstances, will surely develop itself, and such a wine will run much greater risk of becoming bad than one which has no such hidden taint.

With all red wines, therefore, avoid the contact of air during and after fermentation. Before the process has commenced, however, the grapes and must cannot be too freely exposed to the air. The modern enologues have shown that the action of oxygen on the various principles of grape juice, and more particularly the black grape, is of the most beneficial kind, and they recommend the frequent agitation of the must, and exposure of the mark to the air, before the fermentation commences, but they enjoin its rigid exclusion as soon as the process begins. "This action of the air which we must afterwards so rigorously avoid in the wine, cannot be too much encouraged in the must. In pushing the exposure to an extreme degree we need fear no dangerous consequences."

So susceptible are all wines of any acid or fetid taint, that the presence of any sour or decomposing matter in the cellar is apt to affect injuriously the wine in cask, and the utmost care ought to be taken to remove everything that has a tendency to decomposition. When the cloth which covers a vat has become wet or damp during the violent fermentation, it ought to be removed, and another carefully slipped over without agitating the carbonic acid, which is the real covering.

The mode of fermentation with the false lid just described, ought to be followed in every case where the mark is fermented with the must, in order to avoid the sourness and mouldiness contracted by the head, or mark, when exposed to the air. Some do not employ the false lid, but endeavour to counteract the evil effect of exposure of the mark, by constantly beating it down into the fermenting must. A must ought to be very rich in saccharine principle which can bear with impunity this constant oxygenation of the mark; and yet it is practised in France, and recommended by the best authorities. "The greatest care must be taken to prevent the wine from becoming acid, for, during fermentation, by the escape of carbonic acid, a superficial covering (chapeau) upon the wine speedily forms, by which means the alcohol is exposed to the influence of the air, under circumstances resembling those which facilitate the rapid formation of vinegar. To prevent the formation of this superficial covering (chapeau) the skins must be constantly stirred."*

This system of stirring the skins, or beating down the mark, although followed in some of the best wine districts of France, cannot be regarded as a safe practice, especially in countries where the temperature during fermentation is generally high. So important is this subject, of the danger of acidity from exposure of the mark, that I shall again cite the opinion of one of the writers already quoted:—"If We shall now take into consideration a question which has caused much discussion among œnologues, and which is not, perhaps, entirely settled at this day. This question is, if vats ought to be open or shut. At first sight, the keeping the vat shut seems unnecessary. When the must is introduced into the vat at a proper temperature, and all precautions taken to preserve the heat"—(this is in France, where the vintage season is often cold)—"the fermentation is lively, and the ebullition tumultuous. The carbonic acid disengaged forms a bed or layer over the liquid, and prevents the air from penetrating to it, as completely as the best coverlid. Even where the fermentation is less active, the gas is generally quite sufficient to produce the desired effect. We cannot, however, regard this gas as a sufficient covering on all occasions. When it is not disengaged with sufficient vivacity, the air becomes mixed with it to such an extent that it ceases to affect the flame of a candle; in such a case the must always suffers, part of the alcohol is changed into vinegar, the tartar and azotized matters ferment and produce mouldiness. If the head (chapcau), that is to say, the crust more or less thick formed by the stalks, skins, &c., raised by the bubbles of carbonic acid, is formed under these conditions, the danger to the wine becomes very great. This head, this spongy mass, filled with ferment, causes a most rapid oxidation of the must with which it is impregnated, and produces vinegar from the alcohol as quickly as it is formed from the sugar, and makes a most detestable wine. These results have almost invariably been the consequence of filling open vats to the brim, or when the head has not been kept down in the must. It is, therefore, useful to cover the vats, because the coverlid retains the carbonic acid; and where the gas is produced slowly, the little which does form remains on the surface of the liquor, and prevents the evil influence of the air."

Where the mark is allowed to ferment on the husks, and more especially with red wines, it may be laid down as a rule that the air ought to be excluded. Where the must is fermented without the husks, the question as to open vats is yet undecided.

For many years a furious wordy war was waged in Europe between the advocates of open vats and close vats. Many good arguments were brought forward by one party in favour of their system, and best argument of all, excellent wine; while the other party answered with reasons as good and sound in favour of theirs, and produced a wine quite equal to that of their opponents.

Both parties, however, have taken a too partial view of the matter; they have not sufficiently considered the various concomitant circumstances which influence fermentation. The temperature of the air, if high, would be altogether incompatible with an exposure of a weak must, while a must rich in saccharine principle would require both elevation of temperature, and, perhaps, free

exposure to the air to complete its fermentation. The kind of grape, too, has to be considered as bearing on this subject. There are varieties which require a free exposure to the air to complete their fermentation, and which can hardly be pushed into the acetous stage; while others, under ordinary circumstances, run through their alcoholic fermentation with rapidity, and are with difficulty prevented from passing into vinegar. This subject will again come under our consideration.

Generally speaking, the must of warm climates requires a free exposure to the air to complete its fermentation, and such will be found to hold good with the white wines of the warmer parts of Australia.

For fermenting white wines, I have recently caused to be made of the best Moreton Bay pine, two inches thick, vats 6 feet diameter at bottom, 5 feet 4 in. at top, and 3 feet deep. It is proposed to use them as follows:—To commence with putting into each only 9 to 12 inches of must (from 120 to 160 gallons); when all are in use, and the violent fermentation sensibly subsides, gradually to fill up a part from the remainder, to make room for fresh must. By the adoption of wide surfaces and little depth, with free access of air, it is hoped to keep the temperature below 75° or 83°. The more gentle fermentation which follows will be carried on in casks, as before."

We must not bring this subject to a close without mention of the close vat of Mademoiselle Gervais, whose name was mixed up with the controversy, and who is best known through the apparatus she invented, and which is still in favour with a few.

It is a vat closed at top by an air-tight lid. The vat is filled from an opening in the lid, sufficiently large to admit a man to enter and clean the vat when empty. This opening is firmly closed by an iron plate, in which is a small hole, kept shut by a weighted valve, as at A. The tap R is fixed at the lower end, having an elongated sieve I behind, to strain the wine when it is drawn off. A bung hole D is also made near the bottom, to allow the carbonic acid to escape after the vat is emptied. During the fermentation, the only way in which the carbonic acid can find egress is by the tube T, the extremity of which is inserted in water.

It was supposed that this vat possessed the great advantage of retaining both the bouquet and flavour, and also the alcohol, much of which escapes in open vats along with the carbonic acid gas. How much of the bouquet and flavour is thus retained it will be difficult to estimate, but if it does not exceed the loss of alcohol, it must be very inconsiderable. Guy Lussac ascertained that the spirit, condensed by the water through which the carbonic acid passed from this air-tight vat, did not amount to the sixteen-hundredth part of the spirit in the wine.

Having discussed at some length the subject of fermenting vats, we shall now proceed to consider the other cellar arrangements.

It is hardly necessary to point out the strong stands required for the vats and casks. For the vats, these ought to be of moderate height; 15 inches is sufficient to allow a shallow tub to be placed under the chime when the wine is drawn off. Several tubs of various sizes, from 10 to 50 gallons, must be provided, and six light buckets. When these buckets are in use, it ought to be a rule in the cellar never to place them on the ground, where they are sure to pick up the earth and soil, and may be heedlessly dipped into wine in this filthy state. Let little stands of wood, such as squares of deal of 10 or 12 inches, be provided, on which the buckets can be placed when put out of the hand. A large funnel, of an oval form and considerable size, is also required; it ought to be 18 or 20 inches in length, and 9 or 10 in depth; the pipe is fixed near one end, and a partial lid covers the same end to prevent the wine from dashing over. There are two projecting portions on the under part to cause it to rest more firmly on a cask.

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The casks required to receive the wine after fermentation may be sherry butts or brandy hogsheads. On no account should rum, gin, or whiskey casks be used. Port wine pipes answer well for red wine, but they, as well as the sherry casks, must be thoroughly cleansed from all impurities. There must also be a few quarter-casks (28 gal.), and some smaller, of 10 or 12 gal. to receive odd quantities of wine, and a few stone jars of 3, 5, and 7 gal., will be found exceedingly serviceable. Everything must be stanch and in perfect order, free from all taint and smell, which can be best detected by a little boiling water.

There must be provided means of collecting and transporting the grapes from the vineyard to the wine house. Light buckets are probably the best for the gathering, and these, when filled, are carried to the ends of the rows, where boxes or tubs are placed to receive their contents.

These boxes may be 3 feet by 2, and 18 inches deep, and they may contain about three-quarters of a cwt. There will thus be required 26 such boxes to contain nearly a ton of grapes. As an improvement on the boxes, the following may be recommended:—* “These are tubs shaped like harness casks, about 25 inches diameter at bottom, and 20 at top, and 16 deep. Eight of these can conveniently stand in the bottom of a dray. Upon this tier, another can be placed; and upon these again, the whole or part of a third tier; making, in all, from 16 to 24 tubs, as a load from the vineyard for three or four horses. Each tub has a couple of rope handles for conveniently lifting and carrying either to the dray or the wine press.”

A low truck has been found convenient for conveying the produce from the vineyard.

We now must consider the means for crushing and pressing the grapes.

From time immemorial the grapes have been crushed by the feet, and the treading the wine press has become a subject almost sanctified by its antiquity, and the frequent allusions to it in Holy Writ. Few are disposed to call in question the propriety of continuing a practice which has been followed through all ages, and found to answer the purpose intended.

In Europe, the grapes are still trodden with the naked feet in most of the best wine districts, and there prevails a general prejudice against the employment of any other means of crushing them. The human foot, it is said, causes the proper amount of bruising required to extract all the best qualities of the grape; there is no undue grinding, such as is apt to take place when machinery is employed, and which extracts qualities of a kind injurious to the wine—for instance, by bruising the seeds; but this need not be, with properly constructed machines. There are few winegrowers in these colonies who, after using for a few years the primitive method of crushing, have not been glad to adopt some other mode of conducting the process, less tedious, and, I may add, less dirty. Not that there is anything really so objectionable in the naked feet, when proper cleanliness is observed; the objection lies in the slowness of the process, and slopping and dirt connected with it. Indeed, when the quantity of wine made is very small, 100 or 200 gallons for home use, the treading will be found very convenient. All that is necessary is to provide a large tub, in which is placed a grating, having spaces of about an inch. This lies loosely upon two chocks, and a hole is made in the bottom of the tub to allow the juice to flow into another placed under it. The bunches are then thrown in till they form a layer of six inches on the grating, when the treader commences by crushing them all over the surface. The pulpy mass is then turned over and trodden a second and a third time, to insure the bruising of all the berries. This pulp, or mark, is then removed and subjected to pressure by some convenient means. In the small scale, the lever press answers well; and if the skins are to be fermented with the must, as in red wine, the mark, after pressure, is spread upon a cloth, and the stalks are easily separated with a rake, while the skins are returned to the must in the vat. Where it is thought advisable to tread the grapes on a large scale, the treading vat must be of sufficient size—6 feet by 5, and sides of 18 or 20 inches. This will be room enough for two men to tread in at the same time.

The most convenient mode of crushing the grapes yet devised is by wooden rollers. These are placed upon a frame, and the space between them can be diminished or increased at pleasure. If the wooden surface is objected to as too hard, the rollers may be covered with vulcanized caoutchouc.

The accompanying figure may convey some idea of the machine. The frame is 3 feet 6 inches in height, exclusive of the hopper, which is 18 inches. The side parallel with the rollers, seen here in perspective, is 3 feet 4 inches, while that in face is 2 feet 10 inches. The rollers are 10 or 12 inches in diameter, and are moved by cog wheels attached to their spindles. The motion is further facilitated by a fly wheel. The cogs of the wheels must be of considerable length to allow the rollers to be set nearer or further apart, as may be required. The range required is very small, probably from one-eighth to three-eighths of an inch is sufficient. The hopper must be the full size of the frame, and its lower part ought to fit close to the rollers longitudinally, while the sides must be two or three inches within the ends of the rollers, and made to fit nicely within a quarter of an inch of their curve, so that no berries can escape being crushed. On the top of the hopper is a wooden grating, having spaces of about three-quarters of an inch; the transverse bars, those running parallel with the rollers, are raised two or three eighths of an inch, to facilitate the rubbing off the berries from the stalks, egrapage, for which the grating is intended. The length of the grating in the same direction being 3 feet 4 inches, will allow sufficient room for two men to work together. A shelf with a ledge projects from the side of the hopper; upon this the grapes are emptied; the man on the left draws them upon the grating, and rubbing them backwards and forwards on the projecting bars, separates the berries from the stalks; the berries passing through the grating are crushed by the rollers, and fall into the spout which conveys them to a tub placed to receive them. The first rubbing does not remove all the berries; they are, therefore, passed to the other man, who rubs the stalks until not a berry is left; he then throws them aside into a vessel placed to receive them. The grating must be made to lift out easily, in order to be cleaned, as it soon chokes up. All that is necessary is to knock it gently; this frees it of all obstructions. There must be a platform behind the machine for the men who rub to stand on; also to facilitate the emptying of the grapes upon the shelf.

It may require two men to fill in the grapes into the machine, one at the handle, and one to empty the crushed grapes and skins into the fermenting vat. This makes in all six men, and the quantity of grapes which they can crush in an hour is about a ton, which may be reckoned to make a hundred gallons of wine.

In the treading vat, two men can hardly get over one ton each in a day. Another man is required to fill the treading vat and remove the must and mark, while a fourth may be wanted to separate the stalks from the husks.

In point of economy of labour then, the rollers have an immense advantage; and when we take into account the comfort and cleanliness attending the machine, in comparison with the tediousness and discomfort connected with the treading process, there are few who would hesitate in their choice. The machine above described is that almost universally employed in the wine districts of Adelaide; it was taken from no model or copy originally, and is, in its present state, that

which the practical experience of the last ten years has suggested as the most serviceable.

The working of the machine, as just described, is the mode followed with red wines generally; and with white wines, where the skins are fermented with the must. There may be cases where the stalks are fermented with the must and skins. The grapeage, or separation of the stalk being unnecessary, the grating is removed, and the bunches are at once thrown into the hopper. The rollers in this case require to be a little further apart than where the berries alone are crushed.

Where the must is fermented alone, the whole of the mark must be separated after crushing, by placing it on a large strainer, from which the must runs into a large tub, whence it is removed to the fermenting vat. Large tubs, having a grating raised a little from the bottom, have been found to answer well. There is, of course, a very considerable quantity of must remaining in the mark after this straining, which can only be extracted by strong pressure. The quality of the must obtained by expression differs much from that which first drains off; and in the case of delicate wines, may be unfit to mix with it. There are many of the harsher qualities of the skins which are yielded by pressure, and which we have it in our option to add or withhold. A certain amount of these is necessary in the stronger full-bodied wines, and a portion of them is always added to sherries.

The effect of pressure in extracting the grosser matters of the mark is shown by the greater specific gravities of the must thus obtained. The following was given by Mr. B. Herschell Babbage as the result of experiments made by him:—The juice of the Verdielho, by simple crushing, gave a sp. gr. of 115·2; that obtained by slight pressure, was 115·5; as the pressure was continued, it rose to 116·5, and finally to 117·0.

It is hardly necessary to describe the screw or lever press, the nature and operation of which are so familiar to all in these colonies, where they are everywhere employed for pressing hay and wool. When the mark is put under the press, it may be confined in a heap by means of matting or straw wrapped round it. On the application of pressure, a quantity of the mark is forced out on all sides; these loose portions are chopped off, and added to the top of the heap, and the pressure again employed. This is repeated again and again until the mark is almost dry. In this state the mark may be kept for a considerable time, until it is used for making spirit. The last pressings are generally devoted to the still, being considered too harsh to mix with fine must.

During these processes of crushing and pressing, there is, of course, a great deal of exposure to the air—a thing much desired before fermentation. Very different is it, however, with the mark and refuse of the red wines after fermentation; this, also, is generally subjected to the press, and the proceeds are frequently added

to the wine first drawn off; the liquor obtained by pressure being thought to add much to the richness and body of the wine. This is a proceeding to be deprecated; the mark, after fermentation, contains little, if anything, which can improve, but much that is highly injurious to wine. The yeast and refuse mixed with the skins, afford a mass of matter in the most favourable condition for decomposition, and it cannot be doubted that the oxygenation which takes place during the exposure to the air, must lay the foundation of acetification, which will develop itself under favouring circumstances.

The pressings of the mark from the fermenting vat, ought, therefore, to be kept apart for an inferior wine, or used for the still. When employed for the making of spirit, it is better to add water to it, and allow it to stand for a few days, taking care that it does not become acid, and then subject the liquor to distillation.

CHAPTER X.

VINTAGE.

THE decision as to the time for beginning the vintage must now be made, and this will be done without much difficulty, if proper attention has been paid to the original planting of the vineyard. If the different varieties have been carefully kept apart, the advantage will now become apparent in the facility thus afforded for the gathering. But, if varieties which ripen at different times have got mixed in the rows, it will be found next to impossible to separate the ripe from the unripe. The following signs by which we may judge of the fitness of the grapes for the press, given in Maro's letters, are perfectly clear and explicit: "When, for twelve or fifteen days, there has been no perceptible increase in the size or the transparency of the berries; when, after this, they become flaccid and leathery to the touch, and are detached from the stalk without the slightest effort; when the bunches for several days have become altogether pendant, and the upper part of their foot stalks brown and hard; when the seeds also become brown and hard, and, upon pressing the berry, separate themselves completely from the pulp, leaving no portion whatever adhering to them; when the juice has become luscious and syrupy, so as to stick to the fingers like the syrup of common sugar, and to impress upon the palate in some sorts, an intense sugary sweetness, accompanied by a sort of glutinous fullness, and in others (often the best wine grapes), in which the sweetness is masked by a sort of harsh astringent quality, the glutinous fulness alone; when the majority of these signs are observable throughout the bulk of the crop, the period of its maturity for the manufacture of dry wine has certainly arrived. In certain varieties there will be many bunches, the foot stalks and seeds of which will not be brown and hard, although the fruit is quite ripe. In such cases the seed will generally be found to be imperfect. The high colour of black grapes must not be taken as one of the signs of maturity; neither must an imperfect colour in some kinds be considered as a symptom of the reverse. Grapes may have attained all the maturity of which they are susceptible, even to the shrivelling upon the vines, and yet be imperfectly

coloured; but, when this happens, it is an almost certain sign that the vine is producing too large a crop. When it is proposed to make a sweet wine, the grapes must be allowed to hang some weeks after they have attained the ripeness above described; in fact, until they have shrunk considerably. It will be found difficult to make a sweet wine when much rain falls towards the period of maturity, when the vines are in a very vigorous state of growth, or when they are producing a large crop. In average years the grapes will be ripe in from five to seven weeks from the time when they first colour or swell to maturity, but they may require two or three weeks longer."

In New South Wales, or rather that portion of it on the east of the great mountain chain, the autumn rains are often very injurious to the wine crop; but this is an evil to which the other parts of that province on the great water-shed to the west of these mountains is little liable; and, as we proceed westward along the course of the rivers, we find autumn rains, such as would injure the vintage, of rare occurrence. "It will sometimes happen that the heavy autumnal rains set in before the grapes are ripe, and this can never fail to produce serious injury. Even twenty-four hours, or less, of hard rain, will cause the berries of some sorts to burst; and when this evil occurs to any considerable extent (unless dry land winds immediately succeed for several days so as to dry them up), rottenness is sure to follow. Should this misfortune take place, there is no remedy but to begin gathering the grapes, taking first the most damaged, and continuing until all the injured bunches are pulled. There is no hope of making good wine from them, but, by adding to the must a large quantity of common sugar (for this purpose the commonest will answer, but the drier and more free from molasses the better, as this substance will not dissolve readily in the must), to the extent of a pound per gallon, a wine may be made which will keep with a little care and serve for common purposes."

As the vintage generally comes before the excessive heats are over, we must select the coolest days when we have a choice. "I consider," continues the same writer, "cloudy weather, accompanied by a few misty showers, to be favourable. It is a general law that, other circumstances being the same, the fermentation will be so much the more violent, as the weather is warmer when the grapes are gathered and pressed. Now, it is almost invariably more violent here than is advantageous for the quality of the wine; the aroma is thus partly lost, and unless there be care taken, there is a great loss of spirit also." The following observations regarding the effect of temperature upon the fermentation of wine agrees so perfectly with our experience in Adelaide, that they deserve particular attention: "The best wines I have succeeded in making have been those in which the fermentation was comparatively gentle and long-continued. It should, therefore, be an object with us to abate this tendency to excessive violence by every means in our power; and with this view, amongst other methods, to choose the coolest weather for gathering the grapes the season offers us. In hot weather, then, I should not recommend the vintage to be deferred, but rather to proceed with the gathering at the earliest dawn, and to cease when the sun has acquired power, resuming the work in the cool of the evening. If it should be impracticable to adopt this plan, and the grapes become heated by an exposure

to a hot sun, it may be partly remedied by contriving to spread them out thinly on cloths or some other clean surface, and exposing them to the cool night air, taking care to crush them the next morning while they are cool. When this last plan is to be adopted, care must be taken in gathering and bringing them home, that they are not crushed or bruised unnecessarily."

"The period for gathering having been fixed upon, a sufficient number of hands should be provided as vintagers, selecting those only who will be attentive and obedient. Each should be provided with a sharp knife (we prefer short strong scissors), and each pair should have a bucket, or other convenient light clean vessel, furnished with a handle to carry it when full. To each pair a row of vines should be assigned, the whole to be overlooked by an attentive, trusty person. The gatherers should be instructed to gather none but the grapes which are fully ripe and sound. Those berries which are rotten or damaged, as well as any portions of withered leaves attached to the bunches, they should be directed to remove before they put them into their vessels. They should be directed to be careful how they cut such bunches as are attached to each other, or to the vine, by any other means than the foot stalk, lest they pull off and scatter on the ground the ripest of the berries." "As the buckets are emptied into the casks (or vessels to to convey them to the crushing vat), their contents should be examined by a careful person, bunch by bunch, if the state of the crop demands it, and all that is either unripe, or rotten and mouldy, separated from the good, removing at the same time any foreign substances overlooked by the gatherers. In sorting them it is necessary to distinguish the really rotten grapes from those which merely have their skins injured, whilst their pulp is sugary and rich, as well as from those which have dried on the bunch like raisins. Observe that all which have commenced to shrivel or decay before they were ripe, are bad, and must be rejected, to be used for vinegar; if left in, they are very apt to spoil the wine."

"From what has been observed, the reader will comprehend the importance of employing as gatherers only such persons as are old enough to understand the directions they receive, and willing to abide by them. Eating grapes amongst the rows of vines should be absolutely forbidden; but all may be allowed to partake freely when they are assembled from time to time at the ends of the rows. If the practice of eating grapes at will be not at once checked, the dirty habit of putting every fine looking bunch to the mouth, and biting off a few of the best and ripest berries will soon become prevalent, until many of the workers become gorged past all power of exerting themselves. Let all be cautioned in this respect before they enter the vineyard, and then let the first refractory person be immediately turned out of it; the example will not be lost upon the rest. In wine countries where regularity is of course introduced into this the most important business of the year, eating grapes is only permitted at meals, and when the labour of the day is finished."

The mode of crushing has already been given, along with a description of the machine; it is, therefore, unnecessary to repeat the the process here. I would, however, urge the necessity of perfect cleanliness in the fermenting house, and

all the implements used. Before commencing work, let the machine, tubs, buckets, vats, and every article used in the work be thoroughly washed with lime-water, and let this be done without fail every day that there is crushing going on. The lime-water may be prepared in the following manner. Into a large deep tub or a hogshead, with the head taken out, put a shovel full of fresh burned lime, and fill it with water, stir up the lime, and let it subside. The water dissolves a small portion of the lime, probably not more than the 450th part of its own weight; this will be about one ounce of lime in three gallons of water. If this lime-water is exposed for any length of time to the air, a white film forms on its surface, and then falls to the bottom; this is repeated again and again, and is the result of the union of the lime in the water with the carbonic acid of the air, forming carbonate of lime or chalk, which, being nearly insoluble, is precipitated. In this way all the lime in solution is soon thrown down as carbonate; but the solution is immediately renewed by stirring up the lime. From the very small quantity of lime dissolved by the water, it is evident that the quantity put in at first will suffice for many tubful of lime-water; but, as the conversion into carbonate is constantly going on, it is well to renew the lime every second day. A bushel of quick lime, if put into an iron bucket, or one of the cylindrical cases in which nails are imported, will keep good for many weeks if properly covered up from the air.

After the work of crushing, &c., is over for the day, let every article be thoroughly washed and scrubbed with a brush; the floor must also be well swept, and a little dry lime sprinkled on any wet or damp places. The necessity of this is known to all who have had experience of the putrid state into which grape refuse rapidly passes when littered about.

We shall suppose the red wine grapes to be gathered, and the crushing conducted according to the directions given. The necessity for the false lid to retain the mark in the fermenting liquor, and allow the extraction of the colouring matter from the husks, has been pointed out, and need not be repeated. The great danger of acetification from exposure of the mark to contact with the air during fermentation has also been urgently pressed upon the wine growers' attention, but not more so than its importance demands. The fermenting must, while charged with carbonic acid gas, has little tendency to undergo the change into vinegar, and the resulting wine is protected from this danger, while it contains a quantity of the gas. But it is very different with the solid mark, the husks and stalks; a very short exposure of these to the air, after the fermentation has begun, suffices to produce, not only the acetous, but various other putrefactive changes. Let every care then be taken to prevent the contact of the air with the mark during fermentation. Before the process commences there is less danger; but, even then, it would not be prudent to allow a quantity of mark to be exposed for any length of time, as, for instance, floating on the surface of the must several days previous to its commencing fermentation. In this case the husks may become mouldy and bad before the process begins. In cold weather, when the fermentation is tardy in commencing, the husks which have escaped through the lid, and float on the surface, ought to be stirred

among the must two or three times a day; but, as soon as the gas begins to rise, the vat must be covered up, and all contact of the air avoided.

In situations suited to the earlier varieties—the Verdot, Carminet, Burgundy, Malbec, &c., the vintage is sufficiently late—the end of March, or all April—to insure cool weather for the fermentation; and, where the sp. gr. is that of a medium must—107 or 108—it is most desirable to keep the temperature of the vats at a moderate height; under 85°, if possible; if 10° lower, so much the better. These grapes, if grown in a climate sufficiently cold to ripen them in April, will contain sufficient fermenitive principle to cause their perfect attenuation in five or six days at an ordinary temperature. The degree of attenuation which such wine attains in the vat may be 99.8 or 99.5; beyond this it has no tendency to go; but it would be safer and better to draw it off as soon as it reaches 100, as it can acquire no good quality from further contact with the husks; and the yeast, by this time, has sufficiently subsided to allow it to be drawn off clear, while the further attenuation, which may reach 99.2 or less, will go on in the cask. Where the finest and most delicate varieties of grapes are grown, it may be advisable to draw the wine from the vat some time before it has completed its fermentation, in order to prevent its acquiring too much astringency and bitterness from the husks. This is done in France, where especial attention is paid to the quality of the wine, but is only admissible with the lighter and medium wines.

In running off the wine from the vat, a hose of leather or canvas ought to be used; and where the vats are placed at a sufficient height above the casks to admit of this, the convenience afforded by the arrangement is very great, independent of the benefit resulting from the exclusion of the air. The ordinary mode of drawing off from the vat by buckets causes a great degree of exposure to the air, and a very considerable amount of slopping, which is avoided by the hose.

In warm districts, where the stronger and less delicate wines are grown, such as the Carignan and Mataro, the wine will be of an entirely different character from that of the preceding varieties. When thoroughly ripened, their must may reach the sp. gr. of 114 or 115, and will yield a wine of great strength, retaining a considerable degree of saccharine richness, a quality which it is desirable for such wines to possess. In the warm limestone districts near Adelaide, these varieties are found to ripen about March; and, from the time of their vintage and high sp. gr. of their grapes on the Upper Murray and its tributaries, there is little doubt that these kinds, as well as the white Spanish, would ripen to perfection, and would be found more profitable than the colder climate grapes hitherto cultivated.

The weather at the time of ripening and the vintage is generally highly favourable for their thorough ripening near Adelaide; and, although they may be left, without risk, to ripen to the required sp. gr. on the vine, it is thought advisable to gather them before they have quite attained this, and allow them to

dry for a few days in the sun: in this way the colouring and other principles in the grape are more fully eliminated than they would otherwise be; the fermentation will be more perfect and complete, and the quality of the resulting wine much improved.

By thus deferring the vintage until the grapes have attained a great degree of saccharine richness, there is a considerable loss in quantity, but the gain in quality will more than compensate for this. Moreover, by deferring the vintage for a few weeks, there is less risk of excessively hot weather than at an earlier period, and more favourable circumstances for conducting the fermentation.

When gathered earlier, the sp. gr. of these grapes may be 110 or 109, and this is the stage at which they have hitherto been taken for wine; and the result has been a perfectly sound and good wine; but it is destitute of character, and possesses none of the higher qualities for which light or medium wines are esteemed; nor does it attain them by keeping.

Notwithstanding these defects, this is probably the wine grown in these colonies best fitted for common domestic use. It keeps well, even under trying circumstances. In this colony (Adelaide), it is largely consumed for family use during the summer following its growth, and will keep well in stone jars, from which it is drawn off several times a day, for several weeks. The grapes from which this (which we may call domestic wine) is made, are the Grenache, Mataro, and Carignan, and sometimes a portion of Scyras. The Grenache generally constitutes about one-half, and the Mataro rather more than a fourth. The Scyras is very useful to mix with the others where they are deficient in colour and astringency, as may happen in damp situations adapted for ordinary garden purposes.

For commercial purposes, the rich, warm wine, resulting from more thoroughly ripened grapes, is preferable. Where the sp. gr. of the must is 115, the wine will possess all the qualities so much esteemed in the pure and genuine wines of the Douro. Wine of this character, which necessarily contains a considerable portion of undecomposed saccharine matter, is supposed by many to require an addition of spirit to preserve it from acetous degeneration. Where the attenuation has been carried to 100, or even 100.5, the quantity of spirit formed ought to be sufficient, under ordinary circumstances, to protect the wine from any danger of this kind. According to the table of M. Maumené, the spirit of the fermentation, were complete, would amount to 18 per cent. of alcohol (.825); but, as there remains in the wine a small portion of undecomposed sugar, we may reckon the alcohol to be 17 by volume, or nearly 14 per cent. weight. This strength is very nearly that of many of strong wines of commerce.

Where it is thought requisite to add spirit to wine, it ought to be done immediately before the fermentation is over. "Experience has shown that spirit added to wine at the time when it is about to complete its fermentation in the vat, combines with it, without communicating any taste of the spirit, and incorporates itself with the liquor in the same manner as that which is produced by the decomposition of its saccharine matter*." To add the spirit at the commencement of the fermentation, or even before it is nearly completed, is very injurious, as it interferes with the process, and may check it long before the requisite attenuation is reached.

In drawing off wine from the vat, the casks which are to receive it ought to be prepared by rinsing with a little warm wine; and, after this is thoroughly drained, by sulphuring. This is advisable with the lighter wines, while, for the stronger wines, the casks ought to be rinsed with spirit; in this case, the sulphur, of course, cannot be used. It is hardly necessary to say that the spirit used ought to be perfectly pure and good. The ordinary spirit obtained from the refuse is generally too coarse for any such purpose.

The operation of sulphurous acid in checking fermentation, has already been mentioned. When sulphur is burned in a cask, it takes to itself the oxygen, and forms sulphurous acid. The air is thus deprived of the power of acting on the ferment and the spirit in the wine, and causing acetous degeneration. Other substances, such as charcoal by their combustion, would cause the same exhaustion of the oxygen; but the sulphurous acid has ulterior effects of a conservative character, which no other substance possesses. In the first place, its further affinity for oxygen, causes it to absorb that element from every accessible source, and become converted into sulphuric acid; and, in the second place, this powerful acid, at the time of its formation, has the power of destroying the greater number of the organic substances capable of inducing fermentation.

By saturating must with sulphurous acid the ferment may be rendered wholly inert, and fermentation prevented. In this way is produced the sulphured wine called must; the process is thus described by Redding: "In the south of France a quantity of wine is made, called must, for which the grapes are trodden and pressed at the vintage, and the wine is fined immediately to prevent fermentation. This wine, or must, is then poured into a barrel, until it is only a fourth filled; above the surface of the liquid several sulphur matches are burned, and the bung closed upon the fumes. The cask is now shaken until the sulphurous gas is absorbed, so that none escapes on opening the bung. More must is then added, and fresh sulphur, and the cask treated as before. This is repeated several times until the cask is full. This must never ferments: it has a sweetish taste, and a strong smell of sulphur. A quantity of proof spirit is now added, and a wine highly spirituous is the product, sometimes called also Calabrian wine. It is generally employed to give strength, sweetness, and durability to wines which lack them." Sulphuring is also employed to preserve empty casks, and prevent their tendency to become sour and musty. These are

thoroughly washed and drained, and a quantity of sulphur burned in them, until the oxygen is completely consumed; the bung is then driven tight, and the cask set aside: in this way casks may be kept sweet and good for many months.

The common way of using the sulphur is by burning strips of cloth, prepared by dipping in melted sulphur or brimstone. This mode of sulphuring is objectionable for the following reason: During the burning of the cloth along with the sulphur there is formed a small portion of a compound of a most fetid nature—the sulphur of carbon. When empty casks have been sulphured in this way, and put aside for a time, they emit, when opened, a noxious smell, which is ascribed to the presence of sulphuret of carbon. It is preferable to burn the sulphur alone, which may be done by placing it in a small cup of iron or copper suspended by a chain from a long tapering bung of hard wood which will fit any size of bung-hole. A small piece of sulphur placed in this cup, and thoroughly ignited, will burn readily, and its combustion may be aided by causing it to oscillate. When a cask is filled with foul air, or carbonic acid gas, the sulphur will not burn. In order to cause it to do so, the foul air must be expelled, and replaced by pure air, by means of the common bellows.

The wine being now transferred to the cask, a further fermentation, called secondary, takes place, and which is more or less active, according to the quantity of saccharine matter left unfermented, when drawn from the vat. This causes a quantity of yeast, and with it any stray skins or seeds that may have escaped from the vat, to rise to the surface, and in order to get rid of them, the cask must be kept quite full to allow them to work over at the bung hole. A supply of wine for the purpose of filling up must be kept in jars and small casks. At first the shrinking from the disengagement of carbonic acid is so great that the filling up must take place several times a day, and it is usual to place the bung inverted, or a vine leaf over the hole; a piece of slate answers the purpose well. When the effervescence has nearly ceased, the bung may be fixed at first lightly, and afterwards firmly in the cask; the filling up may then be sufficient once a day, and finally during the winter, once in two or three days. Equal care must be taken to keep full the small casks and jars kept for filling up the large casks. When these are required for use, the wine ought to be bottled off and corked, and not drawn off from the cask in small quantities as wanted.

When casks are neglected and a void is allowed to form at the bung, the consequences are most disastrous to the wine. The action of the air on the surface of the staves, moistened with wine and barmy matter, is to induce that acetous change which is above all things to be dreaded. If the cask is now filled up, the vinegar which has been formed and impregnated the staves, becomes mixed with the wine, and commences the acetous degeneration which is the ruin of much wine in these colonies. If the wine is strong in spirit, it may be able to resist the deterioration, but the vinegar remains there unchanged, and, though masked by the strength and sweetness of the wine, would, under favouring circumstances, act as a leaven to cause the further acetification of the wine.

There are some who maintain that vinegar thus formed may be reconverted into spirit; this is very doubtful. Wine, which has become acid, has, after a time, recovered its soundness when left entirely to itself. This has happened sometimes with white wines, but never, that I am aware of, with red. It is probable in such cases, and they are frequent, not only with wine, but also malt liquors, hard or apply ale for instance, that the acid is not the acetic, but one of the acids formed in living plants, the malic, citric, or other, which are converted into sugar, during the ripening of the fruit, and which may be termed vital acids, in contradistinction to the acetic, which is the product of decomposition or destruction.

But whatever theory we may form regarding the acetic acid, we know practically that it is the dread enemy of the wine-maker, and must be guarded against at all stages of the wine's progress. Even the smell of a sour cask is apt to endanger wine in its vicinity; and every precaution ought to be taken to counteract, by means of quick lime, acidity in the cellar from any cause likely to engender it, such as spilling of wine on the floor or leakage. When the wine is fermenting over at the bung, the yeast should be frequently washed away from the bung hole, and the bung and cloths frequently rinsed in lime water. When the casks can be closed, great advantage will be found in the use of long conical bungs of hard wood which can be driven tight, and require no cloth. If made of any of the native hard woods, they must be steeped some time in water to extract any astringent gum they may contain.

The fermentation of the red wines has been first discussed, as being that in which there is little diversity in practice, the same process applying to all red wines, no matter what the difference in their specific gravities; with white wines, on the contrary, there are various modes of conducting the fermentation, and these, too, founded on the results of successful practice, so that it is difficult to lay down any definite rules for general application. It is not alone the variations depending upon the sp. gr. of the must, and the temperature during fermentation, which require a diversity of management,—the variety of the grape has also much to do with it. Two kinds of grape, grown on the same soil, and of equal quality as to saccharine richness, may require very different treatment in order to cause their complete fermentation.

As a general rule it may be stated, that when the sp. gr. is of a medium height—108 to 110—the fermentation generally proceeds favourably, and issues in a completely attenuated wine. Must of this gravity seems to go through the vinous fermentation more satisfactorily than any other; when the must is below this, the fermentation is rapid in the ordinary temperature of our climate, and the risk of acetous change imminent, while strong rich musts of sp. gr.—112 and 114—sometimes stop short in their fermentation, leaving the wine far from complete attenuation, probably 109 or 102.5.

The experience of the wine growers in New South Wales is in favour of open vats of moderate size, tun butts, 200 or 250 gallons, set on end, and the complete separation of the must from the mark. They also use the press, and mix the first pressing with the must from the crushing. The varieties chiefly cultivated on the Hunter and its tributaries, are the Verdeilho, White Hermitage or Rousanne, White Grenache, Ancarot, Shepherd's White, Reisling, and Pineau blanc. Of these the most esteemed for quality are, Verdeilho, Pineau blanc, and Reisling, but they are inferior to the others in the quantity of their produce. In the report of the annual meeting of the Hunters' River Vineyard Association for 1857, we have the following statement of specific gravities given by M. Carmichael:

Verdeilho 113.6 Shepherd's variety 111.8 Pineau blanc 111.6 The average of 34 observations from different crusbings 108.9

The specific gravity of the mixture,- for it is the custom to combine different qualities,- is not stated, but we may assume that it did not exceed 110.5. But, supposing it to be 110, this is a high quality as compared with French wines, and, according to Schubler, would equal that of the warm wines of the south of France. The gravities of the following year, which was a wet one, were much below those given above, as appears from the report by the same gentleman, in 1858:

Pineau noir 112.4 Do., in showery weather 108.2 Black Hermitage and Lambrusquat 108.0 Verdeilho 108.8 Shepherd's grape 112.2 Do., after rain 106.6 Average of Black Grapes 109.7 Do. of White 107.1

Grapes rich in saccharine principle are generally deficient in ferment, and are apt to cease fermenting from this cause, long before their saccharine matter is converted into spirit; the great quantity of spirit formed is another impediment to further fermentation, as already pointed out under the general subject of fermentation. The frequent result of this imperfect fermentation is, that the unchanged sugar is apt to undergo, after some time, a decomposition by which it is converted into an acid, not acetic generally, but some other, probably malic or acetic, as already stated; such wines may recover their soundness by exposure to the air and warmth. This acidity does not generally show itself until some months after the vintage, and in most cases resists all means taken to remedy it; the wine continues harsh and bad, and in many instances cannot even be converted into vinegar. There are some grapes which seem to be very deficient in fermentive principle, and when thoroughly ripe seldom complete their fermentation; and of these the Verdeilho is perhaps the most remarkable. This is, probably, the highest flavoured and richest of our white wine grapes, and held in great esteem by the wine growers in these colonies.

This peculiarity depends very much on soil and situation; there are localities, generally the driest, in which the Verdeilho almost invariably refuses to complete its fermentation, and in such situations there seems to be a great excess of tartar in the grape, the crushing rollers and vessels through which the must passes becoming incrusted with a hard coating of this substance. In other situations, generally moist, the fermentation goes on without impediment, and produces a perfect high flavoured wine. In such cases the richness of the must does not account for the difference in the fermentation in these instances. In a comparatively moist situation, Felix Stowe, on the Torrens, the specific gravity of the Verdeilho may average 114, while at Trinity, on dry limestone slopes, the same grape averages only 112. In the former situation the result of the fermentation is invariably successful; in the latter, it has happened only rarely that a good wine has been made from this grape.

The deficiency in ferment in this grape has been successfully counteracted in most cases, both in New South Wales and this colony, by mixing the must with that of another grape which has an excess of the nitrogenous element; the Gouais or Aucarot for instance. The same is done in Hungary, in the making of sweet wines from sun-dried grapes; the fermentation being promoted by an admixture of the must of grapes not fully ripened.

The experience of the wine growers in these colonies, is against the fermentation of the husks along with the must of the white grapes, and even the proceeds of the press are by some thought unfit to mix with the pure juice obtained by simple crushing. In this case the grapes, after being crushed by rollers, are put altogether, must and mark, into a large draining vat, and the pure juice which runs off is put into the vat, or fermenting cask. Some wine makers have been most successful when the fermentation was conducted in butts on their bilge, as in Spain; with this difference however, that the cask is not filled above three-fourths, and the bung is fixed from the beginning; lightly at first, to allow the escape of the carbonic acid gas, but afterwards, a little more tightly. When the fermentation has almost ceased the wine is racked off into well sulphured casks and treated in the usual way.

Why must should ferment so differently in vessels of different form cannot be explained; but it is a fact well known to wine makers that if a quantity of must be divided between two vessels of the same capacity, but of different form, or even the same form of vessel in different positions, it will undergo a different modification of the process in the different vessels. "Take, for instance," Sir W. Macarthur writes, "two port wine pipes; set up one with a head out on its end, place the other on its bilge, with a hole a foot square at the bung. Into each put 75 or 80 gallons of the same must; that which is in the latter will probably not ferment so violently as the contents of the former, but the process will be more prolonged."

The mode of fermentation in casks which has been followed so successfully by some in this colony, is, as already mentioned, that pursued in Spain; we may now therefore consider the process of making sherry at Xeres as given in the appendix; and although it cannot be taken as an example to follow, we may glean from it many useful hints and suggestions which may be turned to account.

The varieties of vine cultivated for wine in Spain, are peculiar, as already mentioned, and are generally not much known and little cultivated in these colonies, although the climate in the warmer districts is admirably suited for them.

From the limited experience we have had of them in this colony, there is every reason to believe that they would yield a wine of very superior quality. There is less risk here than in Spain of that great evil—wet weather at the vintage—in the drier districts particularly; and in these districts also, including the country on the Murray and its tributaries, the climate is such as will thoroughly ripen these grapes to the specific gravity desired, without any artificial aid, such as boiling down, or drying after gathering. For dry wines, in general 14° to 17° of Beaumé's scale, corresponding to specific gravities 110.7 to 113.4, are the degrees of strength required in Spain. This is considerably within the limits to which our grapes attain.

The mode of crushing by treading with shoes full of nails, the prevailing practice in Spain, must have the effect of thoroughly bruising the skins, which, in these Spanish varieties, are generally hard and tough the seed must also be broken in this rough process, but as they are not fermented with the must it is probable that little tannin is obtained from them. The use of the yeso, here termed quick lime, it is difficult to imagine, unless it is the absorption of a small quantity of water. In all other accounts we have of wine making in Spain, the yeso is called gypsum, or sulphate of lime, and this is no doubt correct. As an antacid, to neutralize the acids in the fruit, this last can have no effect, although the quick lime would.

While we give up the attempt to explain the effect of the gypsum, and would not be warranted in recommending its employment; at the same time we must not condemn, as useless, a practice so universally followed, although it has not the sanction of science, and has never been the subject of investigation as it deserves.

The subsequent process of throwing water on the mark, and treading it a second time, is, no doubt, suited to the fleshy nature of the grapes. The result of this second pressing, termed agua pies, generally turns out, as might be expected, very inferior to the first pressing, called the yemas. In dry seasons, however, we

are told that the agua pies is very superior to its usual quality, and little, if at all, inferior to the yemas, which, in such seasons, is below its average. The inferior quality of grapes in the drier parts of Australia during a dry season, has already been alluded to.

The mode of fermentation in the butts is very peculiar; these are filled with must to within a fifteenth, to allow room for the ebullition; this space is quite insufficient for the purpose, and the froth and yeast are discharged at the bung hole. Instead of getting rid of this refuse, particular care is taken to save it, and return it to the cask by placing an earthen ware funnel in the bung hole. The reason assigned- for this practice is, that the wine may feed on the lees; and, in order that it may have the full benefit of this rich diet, it is allowed to remain in the same cask untouched until February or March, - - four or five months, - - the bung always open, and no means taken from the beginning to stop or excite the fermentation." On reading this account of the mode of conducting the fermentation, our surprise is, that the result should be anything but vinegar, or something worse; and we are forcibly impressed with the conviction, that grapes, of some varieties at least, and of a higher specific gravity, may produce good wine under circumstances, which, with others, would be ruinous in its results.

Mr. Busby observed a universal carelessness in conducting all the vintage operations at Xeres, and remarked particularly, the bad state of the grapes when brought to the press, many of them being rotten; no selection was made—good and bad were all crushed together. We are quite prepared to hear that wines, made after this system, are difficult to bring into a marketable state; that they remain thick and scuddy, and require many rackings and finings, and much doctoring with strong spirit, to bring them into a state fit for exportation. After reaching their port of destination they are apt to degenerate into their old scuddy condition, and are sent back to Xeres to be cured; and there, according to Mr. Busby, the only treatment they receive is, another dose of brandy; the sea voyage, he admits, may also have some curative effect.

It is universally admitted that the only genuine pure wine of the Sherry kind, is that termed Amontillado; which is described as "a pale, thin, nutty, dry, delicate wine. It is produced alike from all dry (dry wine) grapes, in small quantity, and generally accidental; although there are some soils and vines, the Palomino especially, which more than others, yield such wine." It is also stated, that where the soil is lighter there is a probability of a greater portion turning out Amontillado.

In the very unfavourable circumstances under which the fermentation is conducted, it is certainly wonderful that a pure wine of that nature should ever be produced; but by a more careful, I may say a more rational mode of conducting the vintage operations and fermentation, there is every reason to believe that, instead of being the exception, the pure, dry, perfect wine would be the normal result. Where wine has been made from these grapes in this colony,

and the process has been conducted with ordinary care and attention to established principles, the wine produced has been of a pure and perfectly dry kind. In one case which I may specify, the crushing was done with ordinary care, and the pressure employed was not so great as to extract any of the coarser matters from the skins. The must, completely separated from the mark, was fermented in an open vat, covered with a cloth, and when the fermentation ceased, was drawn off into casks. In the cellar it received the usual attention, and in two years exhibited all the qualities of an Amontillado of five or six years old, with exception, perhaps, of the nutty flavour so much esteemed by some palates, though not by all.

Mr. Busby takes notice of the vineyard of Don Pedro Domecq, which was cultivated with particular care, and whose mode of conducting the fermentation was an exception to the usual method pursued in the country. Instead of putting a funnel into the bung hole to return all the yeast and refuse into the wine, he filled up the casks as soon as the violent fermentation was over, that the yeast might work over and escape. "He also racked off his wine in two months, or a shorter time, instead of allowing it to remain on its lees in the cask in which it was fermented, until March or April, as was the general custom."

The system of boiling down the must to enrich wines, as followed in Spain, is one of very general and very ancient practice in warm wine countries. With the light delicate wines of colder climates, which owe their excellence to their fine bouquet, the concentration of the must, by boiling, is altogether inadmissible; but in the wines of the South of Europe, the addition of the boiled must enhances the qualities for which they are prized. These wines being destitute of the bouquet of light wines, and esteemed only for their richness and full body, any deficiency in these qualities may be made up by concentrating the grapes, either by drying in the sun, or boiling down part of the must, and adding it to the remainder before fermentation.

The usual extent to which must is reduced by boiling is one-third; but Mr. Busby mentions having tasted some which was boiled down to one-fifth. "It was as thick as treacle and resembled it in flavour, but with a strong burned taste." This would, no doubt, be useful in the manufacture of BROWN SHERRY. This ancient custom of boiling down the must, is spoken of, and even recommended by some of the French cenologues; and in M. Maumené's work we find the following humorous passage relating to the antiquity of the practice; as it would lose its piquancy by translation, it is here given in the original:—"Mutardi ben Gasif, poète arabe, raconte une discussion entre Noé le premier des vignerons, et le diable. Au sortir de l'arche, Noé ne peut retrouver la vigne parmi les vegeteaux qu'il avait conservés. Gabriel l' avertis alors que le diable la lui avait volée, parce qu'il y avait droit. Noé le fit venir sur-le-champ, et lui dit: O maudit, pourquoi m'as tu enlevé la vigne? Parce qu'elle m'appartient, repondit le diable. Partages-vous-la, reprit Gabriel. Eh bien! j'en prendrai une moitié, et il prendra l'autre. Cela ne suffit pas encore, dit Gabriel, il faut qu'il en ait deux tiers et toi un seul;

mais quand ton moût aura bouilli sur le feu jusqu'à ce qu'il soit consommé des deux tiers, l'usage du reste te sera accordé.

"Ne nous arrêtons pas à estimer la part du diable; voyans seulement dans le jugement de Gabriel une preuve de l'avantage que présente le moût réduit, avantage dont la connaissance remonte très-haut; cette fiction le prouve."

The process of boiling down a portion of the must to enrich the remainder, is very inferior to that of drying the grapes in the sun after gathering, and is only to be recommended for inferior wines. Where household wines are made from the table grapes of the garden, the concentration by boiling will be found very advantageous; such grapes are generally poor in quality and low in specific gravity, probably only 106 or 107, and would yield a poor wine unless concentrated. Let us suppose the quantity of must to be 85 gallons, and the specific gravity 107. As it is desirable to raise it to 109, at least, twenty gallons of it are reduced by boiling, in a preserving pan, and any other brass or copper vessel, to one-third, stirring constantly while boiling to prevent burning. This syrup is then added, when cool, to the remainder of the must, and well mixed with it. The specific gravity of the mixture, now reduced to about 71 gallons, may be about 109. The fermentation may be conducted in a sherry butt, on its bilge, with the bung hole slightly closed; and afterwards racked off into a sherry or brandy hhd., which will very nearly contain the resulting wine. The quantity, in all probability will not be above 60 gallons, and in this case there will only remain four gallons after the hhd. (56) is filled. This surplus must be carefully kept for filling up; half of it being put into bottles, the other into a jar. Some would recommend the addition of two gallons of brandy to the cask at the racking off, and for such a wine it may, perhaps, be beneficial. The cask being regularly filled up, it may be racked off in July or August, into two small casks, say twenty-five gallons each; this will leave surplus sufficient for filling up. If this is well attended to, the result, after another racking in October, and fining the following winter, will be, a good warm wine. This concentration by boiling, though perhaps troublesome, is much preferable to the plan frequently recommended of bringing up the specific gravity to the desired point by adding sugar to the must. The boiling down of must, we may add, is only admissible with white grapes.

In Spain, the boiled down must is not added to the other before fermentation, generally; it is more commonly kept in store for several years, and improved with age. It probably, although this is not stated, undergoes some degree of vinous fermentation. It is impossible to keep the concentrated juices of other fruits from fermenting, unless they are reduced to the state of a very firm jelly. The ferment is said to be killed by the boiling, but it is only rendered inert for the time. The aluminous matters which constitute the ferment being coagulated by the heat, and rising to the surface, are skimmed off, but in this way the whole of it is not got rid of; sufficient remains of this, and other nitrogenous compounds, to excite, after a time, the vinous fermentation. We may, therefore, conclude, that a certain amount of alcohol is generated during the mellowing which the concentrated must undergoes.

In this state the syrup is added to the wine for exportation, in quantities greater or smaller according to the class of sherry wanted to be made up. After all this making up and dosing with brandy, we are quite prepared to agree with Mr. Busby, "that no wine can be further from a natural wine than sherry," and that the example of the Spanish wine makers is not one for us to follow in these colonies. The addition of boiled down must ought always to be regarded as a last resource to give body and character to poor wines. As such it is used in Spain, where the greater part made up for export are poor wines brought in generally in skins to the merchants' stores by the small growers in the country; such wines would be worthless for shipment were they not made up with concentrated must and brandy. No good, dry, and properly fermented wine, Amontillado in fact, requires such an addition; neither should our good wines in Australia need such making up, more especially in the districts where the autumns are invariably dry and particularly favourable to the ripening of the fruit. There, with ordinary care, the fermentation ought to be completed in the first instance, and the resulting wine dry and pure. Such a wine should be the aim of every wine grower.

Wines made up with boiled must, are, invariably, heavy, and when taken in quantity, oppressive; and, although in certain states of the system, they may be found to be beneficial and strengthening, they are not, to the natural and healthy stomach, the "wine that maketh glad the heart of man." A modern writer justly observes, "It is a great error to attribute the inebriating quality of wine to its alcoholic strength alone; to do so is to set aside established facts. It is well known that one bottle of a certain wine produces intoxication more readily than three or four of another kind. Besides this, intoxication varies in character; in one case it is mild, joyous, exhilarating, (douse, heureuse, expansive); in another, harsh and brutal, (dure et brutale), according to the nature of the wine, and not according to its alcoholic richness."

CHAPTER XI.

CELLAR.

BEFORE entering upon the winter treatment of the new wine, there are still a few remarks to be made on the preparations to receive it when it is drawn from the vat.

The form of building, already described, may be sufficient for the first years crop, as well for storing during the secondary fermentation in the winter, as for the crushing and first fermentation. Before the coming of spring, however, it will be necessary to provide a cellar in which the temperature is pretty steady

throughout the year. It is said that 55° or 60° is the heat best adapted for keeping wine. In this climate (Adelaide), our cellars are much above this. It is next to impossible to have the average temperature of any cellar, no matter how deep, lower than the average of the locality. The mean temperature of the ground is that of the atmosphere of the place; at the surface it varies with the season, and this variation diminishes as we descend until a point is reached, about 40 feet below the surface, where the temperature does not alter with the seasons, but remains steady at the mean of the place. Below this, the temperature rather increases. The mean of Adelaide is 63.3, this must necessarily be the mean of our cellars, and the depth must be considerable, and the exclusion of the air and heat very perfect, where it does not vary 8° on either side of this. But this will be found not too high for the majority of our wines. The temperature required for ripening wines in the cellar depends in a great measure on their strength; while the weak light wines of the northern wine countries of Europe require a steady, and rather low temperature, to allow them to ripen; the warm wines of the south require a high temperature to bring them to perfection, more particularly the white wines. Of these, some of the richer require not only heat to ripen them, but great alternations of heat and cold, with constant motion, seem necessary to bring about the changes which are to develop their hidden virtues. Witness the Sherries and Madeiras sent repeated voyages to the West and East Indies to elicit their finer qualities. But wine must have progressed considerably towards maturity before it is able to undergo this ordeal with impunity. The ferment and other impurities which remain in the wine in greater or less quantity, long after its fermentation has ceased, must first be got rid of by repeated finings and rackings, that all risk of any untoward change may be obviated before it leaves the cellar.

A temperature varying from 60° to 70° is, probably, best suited to the warmer wines of our climate; and there are many, which, after their second year, will ripen better at a temperature considerably above this. Some recommend the cellar to be kept airy; but this, if it means the free admission at all times of the external air, is quite incompatable with a steady temperature; it would be better to say,—let the cellar be kept clean, dry, and sufficiently well ventilated to secure it from any bad smells; beyond this, the access of air ought to be avoided, for where there is a constant renewal of the air in dry weather, the evaporation from the casks, especially if small, is excessive, and necessitates their constant filling up.

It is a great convenience, as already stated, to have the cellar so situated with respect to the fermenting house, that the wine can be run at once by a hose from the vats to the casks; and to this end, small apertures ought to be left for passing the hose from one compartment to the other. The nature of the casks to be used in the cellar, we have not sufficiently considered, although this is a matter of great interest to the wine maker, and has been the subject of nearly as much discussion as the fermenting vats. It was long the general opinion, that wine, kept in large quantities, ripened better and sooner than in small; and we were told of the very superior wines which were drawn from the Heidelberg Tun, and other monsters of the sort, which contained six hundred hogsheads of wine,

(33,600 gallons); these receptacles were kept constantly full,—only a small portion of their contents being drawn off each year, and the vacancy immediately filled with a newer wine.

The modern ideas of ripening wine are quite at variance with the employment of large vessels, and it is now said the smaller the cask the better. Convenience, or necessity, however, imposes a limit on this; a multiplicity of casks, where small sizes, such as hogsheads (56) are used, greatly increases the labour and expense; hence the employment of larger casks of 100 or 200 gallons in many cellars in these colonies. The greater space required by the smaller casks, is also a great objection to their employment; but Sir William Macarthur, whose experience extends to vessels of wood of 1000 gallons downwards, and of compact stone of double that capacity, deems the small casks so superior to the large, that the inconvenience attending their employment is fully compensated by the more rapid maturation of the wine. He, therefore, recommends the hogshead sizes, two or three tiers of which may be stowed one over the other. "The casks of the second tier are stowed in the intervals between those of the first tier, and the third in the intervals between those of the second. In filling up to supply waste, it is easy to reach the bungs of the under tiers with the hand, but to introduce the wine a small apparatus of tin is required of this form:—

[Здесь был рисунок — воронка с трубкой для налива вина в бочки нижнего яруса]

A is a small funnel, and B the tube prolonged horizontally about twenty-four inches, and curved at the extremity to enter the bung-hole of casks. C is a small candlestick soldered to the tube, a few inches from its extremity, to enable the operator to see exactly when he has quite filled the cask. Holding this little machine in the left hand, he pours gently with the right, from any convenient vessel, into the funnel."* The following observations regarding cellars, are well worthy the attention of wine growers; they are at variance with those already expressed on this subject; but the difference between the climates of New South Wales and Adelaide, especially with regard to moisture, is quite sufficient to account for this discrepancy: "Long experience satisfies us that our wine ripens better, and is less likely to go wrong above ground, exposed to free currents of air, than in a deep, though dry cellar. The loss from evaporation, if the casks are kept carefully filled, is much less than would be expected. The first winter above ground is particularly serviceable."*

The stands, or supports in the cellar, should be such as will suit either large or small casks, and to this end, there is nothing better than large quartering of gum, laid on short cross pieces of the same. For the long pieces, five inches square is a good size, while the short cross chocks may be a little larger, say seven inches, and thirty inches in length. The longitudinal pieces may be placed, as convenient, from ten to twenty inches apart, and the number of cross

supports may be apportioned to the weight they have to sustain. By having the supports in this form, they can be adapted to any size of cask.

We must now revert to the treatment of the white wine in the cellar, after being drawn from the vat. This does not differ in any respect from that of the red wines in the same stage, as already described, the casks being well sulphured and the filling up conducted with the same care and regularity. The casks must be constantly looked to in the cellar, lest any leakages occur; these must be remedied immediately. If slight, a useful temporary cure may be found in a putty made of tallow and chalk; but if more serious, a small portion of white lead of the consistence of putty being put over the flaw, a piece of lead nailed firmly over it, will form a more permanent stoppage; but the only real remedy is, the running off the contents into a sound cask.

During the first two or three months in the cellar, a considerable quantity of lees, consisting of ferment and feculent matters, is thrown down and forms a deposit at the bottom of the cask; and the wine itself, under ordinary circumstances, is so far purified as to appear clear in the day light. As the season advances towards the spring, and the rising of the sap in the vine, there takes place a disturbance in the wine, by which the sediment gets partially mixed up with it again, to the great risk of originating other destructive changes. Whether the wine has still any of the original vitality of its origin, or sympathy with the plant, it is impossible to say, but it is well known to all who have had experience in the management of young wines, that a disturbance takes place in the wine at stated periods, corresponding with the rise of the sap in August or September; the flowering in October and November, and the ripening in February and March. And it is asserted that these commotions are independent of any change of temperature. Be the cause what it may, we have to do only with the fact; therefore during these seasons the wine ought not to be disturbed; the intervals of quiescence being chosen for the racking.

In anticipation of the disturbance in spring, the new wine ought to be racked off in July: this is the prevailing custom in these colonies, when the wine has been drawn from the vat, after its first fermentation, sufficiently attenuated, and pretty clear and free from sediment. Where the wine has been drawn off before the alteration was complete, as with sweet and liqueur wines, there is difficulty in getting rid of the ferment without repeated rackings, sulphurings, and finings. It is the practice of some wine makers to have several rackings, even of dry wines, before the spring. Such a practice is of questionable benefit.

The danger of oxydation and its sequel, acetification, from the exposure of the wine during repeated rackings, is strongly insisted on by M. Maumené.

"One of the most important objects to be attended to by the wine maker is, to guard against the contact of the air. Many do not attach sufficient importance to this. They do not conduct the rackings with care, and do not consider in how far, and in what way, the operation favours the absorption of oxygen from the air.

"It is true that wine may undergo several rackings without injury, but this is from the presence of the carbonic acid which is still retained in it, after it has been exposed to the air, in an unbroken column running from the tap. But the persistence, this retention of the carbonic acid, has a limit; it is therefore necessary to mark two conditions under which the drawing off the wine may take place. In one case the tap allows the wine to run in an unbroken column, and the air comes in contact with wine only on the surface of the column; in the other the tap breaks the column and causes the wine to flow in a multitude of small streamlets; one single exposure, such as this, may be destructive. It requires nothing more to effect the deterioration, the wine will pass into the state of vinegar after the absorption of even a smaller portion of air." When we add to this exposure in running from the tap, that which must take place from turning over the wine into the funnel, it is easy to see that the oxygenation to which wine is subjected in the ordinary mode of drawing off is very great, and such as must be very hazardous to a delicate light wine. To obviate the danger of such exposure, there has been used in France for a considerable time an apparatus known by the name of Souflet Champenois, which has been found to answer well the end for which it was first intended, and also saves much of the trouble and labour attending the ordinary process. Sir William Macarthur, who has used the apparatus constantly for the last twenty years, recommends it to the attention of wine growers. "By all means let every wine maker, not an amateur, supply himself with this simple apparatus. It saves two-thirds of the labour in racking wine and much of the messing and slopping which accrue when it is drawn off into buckets to be poured into other casks. They can be obtained from any respectable source in almost any of the great wine districts of Europe. We have obtained them from the Rhingau and from Bordeaux."

"Three men, one of them to wash and thoroughly cleanse the casks as they are emptied, for immediate use again, can, with ease, rack off three or four pipes per hour, by means of this apparatus, and more clear wine is obtainable than by any other mode."* The accompanying illustration, intended to represent the apparatus and mode of working it, is taken from M. Maumene's Travail des vins, &c.

[Здесь был рисунок — устройство для переливки вина с помощью мехов]

T being the full cask, and T' the empty one into which the wine is to be drawn, we commence by driving into the full cask a large tap C, represented separately in D. Into this is firmly fixed the wooden tube b, one end of which is attached to either extremity of a leather or caoutchouc hose m. The form of the wooden tubes of the hose is represented separately at G. The plug is taken out of T' and

the wooden extremity of the hose b' being inserted, is firmly driven with a wooden mallet. On turning the tap C, one half of the wine passes immediately into T'. The bellows, or blower, is now adjusted and firmly fixed in the bung hole of T, and the hook r driven into the cask to steady it. The bellows being put in motion, the air accumulates in the cask, presses on the surface of the wine, and causes it to flow into T' until it comes down to the level of the tap, when the first sound of air passing is the signal to stop. The tap C is then shut, and the bung of T' firmly driven. The wooden tube b' of the hose, is now removed smartly, and replaced by a wooden plug. The shallow tub u, is intended to receive the wine in the hose as well as that which escapes on removing b'. The cask T, is filled up and the bung closed.

Instead of fixing the extremity of the hose m, in the lower part of T', it is sometimes introduced into the bung hole. It is then necessary to use the blower from the beginning; and when this is done, the extremity of the tube ought to reach the bottom of the cask, to prevent the exposure of the wine to the air. Before using the bellows the cask to be filled ought to be sulphured. There remains in the cask from which the wine was drawn, a small quantity of clear wine below the level of the tap, which is to be taken off by gently raising the cask behind; taking care to stop as soon as there is the slightest appearance of cloudiness.

Regarding the subsequent rackings there is a diversity of opinion, as to the frequency with which they ought to be repeated. Dreading the effects of oxygenation, some limit their rackings to that of July, already mentioned, and a second after the vintage, in April or May; others, deeming the racking the chief means of ripening the wine and rendering it fit for use, rack more than once in the interval. We shall now consider the nature of this process of ripening, and the opinions of modern writers on the subject.

It would be difficult to give any other definition, or rationale, of the ripening of wine, than describing it as a slow process of oxydation, by which the aluminous matters become changed into insoluble compounds and are thrown down as lees, while chemical changes go on between the alcohol and the acid, and other constituents of the wine, by which its aroma and flavour are developed. This action of the air, or oxydation, takes place through the pores of the wood, and is one of those mysterious operations which are effected only with time. It cannot be hastened; a more free exposure to the air induces an oxydation of a different kind, whereby compounds are formed between the oxygen and alcohol which tend to destructive changes in the wine. According to the modern chemists, an intermediate compound, aldehyde, is first formed, and this is ready, when a fresh opportunity occurs, to absorb more oxygen and pass into vinegar. Through the pores of the wood there also takes place another action of an important kind; this is evaporation; but not of the wine, nor yet of its more volatile constituent, the alcohol, as might have been expected, but chiefly of the watery element. The effects of the changes in the constitution of the wine thus induced are of great moment to the wine maker, and deserve particular attention. The following

passages on these subjects, by Mulder, are so clear and explicit that they are here given in extenso:

"The ancients knew that wine improved if kept in leathern bottles, and the same result is obtained by keeping it in wooden vessels; for both leather and wood are more easily penetrated by water than by alcohol; evaporation ensues from both, but more freely from water, and the wine consequently becomes richer in alcohol. Sommering's experiments rendered this very intelligible, since by putting weak spirit into a bladder and hanging it in a warm place, he increased its strength. Later observations have caused Sommering's result to be received with modification, so that the simple evaporation of water is no longer spoken of since it has been ascertained that a certain quantity of alcohol, though proportionately less, evaporates with the water.

"Even supposing equal quantities of alcohol and water to be evaporated, the wine would still be improved, as all the other constituents would remain undiminished. But Graham, a short time since, proved that if diluted alcohol were put into a bladder, the water would really evaporate and the spirit be concentrated. Schubert, on the contrary, asserts that wood allows a readier passage to alcohol than to water, and maintains, as proof of this, that spirit-of-wine loses strength when in a wooden cask. Even if it be so, it does not follow that wine, which contains less alcohol than water, should allow proportionately equal quantities of each to evaporate.

"Wine stored in wooden casks, loses therefore in water, whether mixed with alcohol or not. But if evaporation affects the contents of the cask the loss must be repaired, otherwise the action of the air would turn the wine sour and convert the alcohol into acetic acid.

"It is chiefly water which is evaporated, and its loss is made up by adding wine. All the constituents of wine, with the exception of water, are hereby increased, and the wine becomes not only stronger but better flavoured. The vinous components being more concentrated, are better able to act chemically upon each other; and this alone would account for the improvement of the wine. Here we have a general statement of the causes upon which the difference between new wine and that which has been stored in casks, mainly depends.

"The drier the atmosphere is which surrounds the casks, the greater will be the evaporation. To avoid this, care must be taken to prevent draughts, and to keep the air of the wine stores or cellars moist.

"The larger the casks the smaller will be the surface in proportion to the contents. The observation has been made with respect to Sauterne wine, that

whilst in casks containing 50 gallons, the evaporation, one-twelfth; in casks holding 1000 gallons, the evaporation only amounted to one-twentieth."

The paramount importance of this subject demands the earnest attention and study of the wine maker, and will excuse the urgency with which it has been pressed upon the reader's attention by frequent reiteration. With the dread of the destructive effects of oxygenation before him, the wine grower may be led to abstain altogether from racking his wine; and well he may be, when the wine is drawn as it is usually done, by a plug hole into a tub, and thence by buckets into a funnel. But all risk from exposure is entirely avoided when the racking is done with the racking bellows; they may then be as frequent as those of some of the Hunter River growers, without fear of injury. Mr. Blake, at Irrawang, racks off, during the first year, in June, August, October, and December; the wine then remains quiet, in large casks, until the next vintage is over. These large casks are used for convenience, and not from any advantage to the wine. The racking never takes place in hot weather. Red wines do not require so much racking as the white, but ought to be guarded with greater care from the access of the air. In order to facilitate the ripening, the precipitation of the sedimentary matter is hastened by means of finings. These are generally used previous to the second or third racking, and consist principally of isinglass for white wines, and white of egg for red. For a pipe (100 gallons) of red wine, the whites of a dozen eggs are beat up with a little wine drawn off from the cask. If a rotatory motion is given to the wine in the cask, by means of a stick, the fining then added, and the motion of the stick reversed, there will take place a thorough diffusion of the finings through the wine. After being tightly bunged and allowed to remain quiet for two or three weeks, it will be found to have deposited a quantity of sediment, and become clear and bright.

This fining may be repeated in six or eight months, when the wine will, in all probability, be bright enough to show no cloudiness when held in a wine glass before the flame of a candle; it is then said to be candle bright. White wines are not so easily fined as the red, and require a much longer time to bring them to perfection. The finings for white wine may be prepared in the following manner: "Take half-a-pound of the best isinglass, wash it quickly in cold water, and put it into a large earthenware bason. Pour on it a pint of good clear white wine, and let it stand half an hour in the sun to soften; then add more wine, and work it well with the hand; add wine until you have three gallons. In twenty-four hours it will be a jelly. Bottle and cork, and it will keep three months. One quart of finings is enough for 200 gallons. For use, take a pint of finings and divide it between two buckets; add a gallon of the wine to be fined to each bucket; use a whisk of willow-wands until they foam; pour rapidly from one bucket to the other, adding more wine; then put the whole into the cask, which must be agitated as much as possible."*

The action of the finings in clearing wine is, in great measure, mechanical, and may be thus described: When mixed with the wine, it is brought into contact with, and unites itself to the tannin, or astringent principle, which has been

already described as being extracted from the husks, during the crushing of the grapes. During this union, the gelatine coagulating, entangles many of the insoluble matters suspended in the wine, and carries them with itself to the bottom. Where there is a deficiency of tannin in the wine, the necessary coagulation and precipitation do not occur; in such cases it is customary to add tannin either in the form of pure tannin acid, or by a tincture of gall nuts. Other matters have been used for finings; the only one we need notice is milk, which is now pretty generally employed; but this is better adapted to old wines, as when in the merchants hands for bottling.

Fining is an interference with the natural ripening of the wine, and ought to be dispensed with when the wine will clear itself spontaneously, which it sometimes does. Some condemn the fining of new wines. Sir William Macarthur says, "I prefer never to use them with young wines, say until three years old. Some wines refuse obstinately to become bright. Exposure to cold, almost to freezing, will greatly assist in causing almost all foul wines to deposit."*

In the very warm white wines of Madeira, and the South of Europe, there are changes which take place during their ripening, of an entirely different kind from those of the ordinary light and medium wines, which have not hitherto, as far as I am aware, received the attention of scientific men, that they deserve. Such wines, at one stage of their existence, are sometimes extremely acid.

Whence comes this acidity; and what is its nature? According to Mulder, "the concentration of the wine, or rather the diminution of water, which is constantly replaced by wine, causes a constant increase of tartaric acid in the wine. Wines which are poor in sugar may easily become too sour; and all wines, therefore, cannot undergo this process. The quantity of tartar (supertartrate of potass), in the wine is not increased, for being insoluble in alcohol the continual increase of alcohol precipitates it. That which is increased is tartaric acid, which is soluble in alcohol, and not insoluble cream of tartar, (supertartrate of potass)." Leibig, as well as Mulder, maintains that there is a transformation of this tartaric acid into sugar, similar to that which takes place during the ripening of fruit; and the sending of wines, such as Madeira, to warm climates to improve, seems to be acting on this theory. Such wines have little or no tendency to pass into vinegar, and bear much exposure and risks that would ruin any other wine; with Madeira, indeed, a systematic exposure to the air seems to be necessary to complete its ripening. The time requisite to bring these strong rich wines to perfection, is much greater than that required for the lighter or medium wines generally; these last may be used when three or even two years old, although they have not arrived at perfection; but the strong wines require more than double that time to develop their qualities, or make them even fit for use. Much, however, depends, in all probability, on the manner in which the fermentation is conducted, the form of the vat, the nature of the cellar in which the wine is stored, and many other particulars.

CHAPTER XII.

VARIETIES OF VINE.

THERE is, perhaps, no subject on which it is more difficult to advise the intending wine grower, than in the selection of varieties of the vine. There are now a great many excellent kinds whose characters have been fully established in these colonies, but these vary so much in their quality and productiveness in different soils and situations that it is impossible to say how a particular grape may turn out when transferred to a new and untried locality.

The opinion frequently expressed, that it is soil and climate chiefly which cause the varieties in the wine, and that the same vine, grown in different situations, will give wines of entirely different qualities, is not altogether correct, and can only be entertained by those who have no practical acquaintance with wine growing.

The different varieties of the vine are as distinct as those of any other fruit-bearing tree, and although under different climate and soil, they seem to undergo some change, this is merely a slight modification of character. The Black Hermitage vine, for example, is one which is marked by striking peculiarities in its form and in the quality of its fruit. On the hill of the Hermitage—from which it takes its name—it yields a wine of very high character, which is not to be equalled in any other part of the world; but there, as elsewhere, it presents the same distinctive features in its mode of growth, and the general peculiarities of its produce. In Australia, as in Europe, it has the same long jointed shoots, and indented leaves with a white downy under surface; while the fruit forms in long open clusters of black oval grapes, and yields a wine remarkable for its peculiar dark colour and astringency, which makes it valuable for mixing with other wines deficient in these qualities. A Muscat vine is the same in all parts of the world, and yields a grape of a musky flavour, more or less strong, and this flavour it never loses by any change of soil or situation.

The principal modifications the vine undergoes by change of situation and climate, and which are most interesting to the wine grower, are alterations in the quantity of saccharine matter in the fruit. Those vines which are most valued in France for the delicacy and fine bouquet of the wines they produce; the Pineaux, for instance, from which are made some of the most esteemed wines of Burgundy and Champagne, when transported to a hot climate lose their high bouquet, and become extremely saccharine. In France, the specific gravity which the Pineaux attain is about 108, while in the warm districts of Australia they attain a specific gravity of 111, 112, and even more. We have thus a much stronger and richer wine, but the increase in strength will not compensate for the loss of bouquet for which the delicious wines of Epernay and the Côte d'Or are

valued. The quantity of produce also is small when compared with that of the more vigorous vines of warmer climates; and it possesses no superiority over them in point of quality to recommend it to the wine grower.

It has been laid down as a general rule, that a vine which is a large bearer yields a wine of inferior quality, while all those vines which give a high class wine are small bearers, and that the same vine grown on a rich soil, and thus rendered more productive, yields a wine of inferior quality to the smaller quantity produced on a poorer soil. This applies more to cold than to warm climates. In cold countries the vine can ripen only a very limited quantity of fruit, and if forced by a richer soil to produce more, the fruit is poor and ill ripened. But in warm climates, especially in Australia, where the ripening influences of heat and direct light are excessive, the vine will grow luxuriantly in a rich damp soil, and produce large crops of perfectly ripened fruit. Many of the best varieties cultivated in these colonies fall off, not only in quantity but also in quality, when planted in poor soils; and this is not more marked in the dry situations near Adelaide, than in the more moist climates of the east coast of this continent. In the Hunter River district, according to Mr. J. E. Blake, the richer and more productive soils produce a wine of superior strength and quality to that grown on the poorer and lighter soils; the produce of the latter is also characterized by its inferior keeping quality, and the use of manures had been found beneficial in improving the quality as well as the quantity of the produce. The varieties of the vine cultivated in the Hunter district, are all of a good, and many of fine quality. The result of manuring, or natural richness of soil, would be very different with grapes of an inferior quality; as for instance, many of the Chasselas varieties, and still more, some of the wretched kinds brought from the Cape to Adelaide about eighteen years since, which are now seldom to be met with, having been either rooted up or used as stocks for grafting on. The produce of such vines is bad on any soil; but when grown on rich ground they yield most abundant crops of most execrable fruit; the large swollen clusters often presenting a mixture of ripe, green, and rotten berries on the same bunch. The quality of the wine from such fruit it is unnecessary to particularize.

In the following enumeration of the vines best known in these colonies, and most generally cultivated for wine, the division into three classes, according to the period of ripening, as in Maro's letters, has also been selected as the most convenient. The list is far from complete, from the want of a general collection of vines in any of the colonies, a want much to be regretted at the present time, when public attention is being directed to the important subject of wine growing. A complete collection would be of great advantage in identifying the different kinds, and removing the confusion which has arisen from the diversity of names by which the same vine is known in different localities.

FIRST DIVISION

Comprises those earlier varieties which are suited to the coldest districts in which the vine can be cultivated, and which, in the quality of their produce, resemble the vines of the north of France and Germany.

Pineau Gris is a small growing vine, which, in our warm districts, dwindles to an insignificant plant, but is well adapted to cold situations, where, according to Maro, it may yield from 200 to 500 gallons per acre. It ought to be planted very close; four feet by two-and-a-half, or three by two, is the distance assigned to this vine.

Pineau Blanc is one of the most celebrated wine grapes in France, producing many of the most famed wines of Burgundy and Champagne. This variety is not a great bearer, but its superior quality has caused its being cultivated in districts suited to the later varieties, and in which its fruit attains a degree of saccharine richness, specific gravities, 112 and 113, which remove it into the class of strong rich musts. The distance assigned by Maro to this variety is the same as the preceding.

Burgundy, or Small Black Cluster is largely cultivated in New South Wales, where it is a steady good bearer, and seems well suited to the alluvial lands. Generally associated with it in the vineyard is the

Miller's Burgundy, a good hardy vine, and also a good bearer. The wines produced from these two varieties is of medium quality, and rather rough; and, according to Maro, are often deficient in colour; a defect which might be remedied by a mixture of the next vine.

Tinta ripens early, producing small close set clusters of rich saccharine fruit, whose juice has the peculiarity of being of a deep red colour, and is exceedingly useful for heightening the colour of other wines; in fact, the whole plant seems charged with colouring matter—the leaves and shoots becoming of a deep crimson immediately after the ripening of the fruit. This is said to be the grape from which the famous Tinto wine is made in Madeira. This variety, as well as the two preceding, is quite unfitted for our warm dry districts, the quantity they produce being exceedingly small. The Tinta, however, is sometimes grown in small proportion to improve the colour of red wines, even in the warm Adelaide plains.

These three last varieties are well suited to the south coast of Victoria, and produce the best red wines of the Barraboil district.

There are several other vines of this class enumerated in Maro's letters, none of which are cultivated in this colony; nor do they seem to be in favour in New South Wales, where the climate is better suited to the vines comprised in the second division. There are, however, two vines included in this first division, which, from their time of ripening in this colony, ought to be placed in the second, and as they are generally employed for making sweet and liqueur wines, —for which purpose they must be dead ripe,—their time for gathering is generally after all the others of the second division are in the vat. These are the Muscat Gris and M. Noir, which we shall class with the Muscat Blanc in the next division.

SECOND DIVISION.

Reisling may be placed at the head of this division, as being cultivated with advantage in the coldest wine districts in Europe, and producing the wines of the finest bouquet on the Rhine. The great superiority of the produce of this wine to all others cultivated in that country, is ascribed, by Leibig, as already pointed out, to the imperfectly ripened fruit; the excess of acid causing the formation of the ether on which the bouquet depends. This grape was imported by Messrs. Macarthur, from the Rhineau, 1838, and it has established its character as one of the most valuable vines in these colonies. It is a healthy hardy plant, and produces moderately in good situations. In the coldest and most elevated localities in this colony, the Reisling has produced wine of the highest character; and at Camden, wine of the most perfect kind perhaps, grown in New South Wales, has been the produce of this grape. In all cases, however, the wine is too strong to exhibit the etherial bouquet of the Rhine wine. The grapes ripen too thoroughly, and give a wine of more body and strength, but at the same time, a rich flavour or seve, which make it particularly agreeable to the palate and grateful to the stomach. In warm districts it ripens to a specific gravity of 110 and 112, yielding a highly spirituous wine, but in general the aroma is not equal to that of the colder districts, and the quantity is small. As a better bearer than the Reisling, though inferior in quality, the following may be recommended for late situations; it is known in this colony by the name of

Tokay.—Whence it obtained its name, it is impossible to say, for it is not supposed to be the grape from which is produced the famous Hungarian wine of that name. There is a grape of the name of Tokai, cultivated on the Upper Rhine, and mentioned by Redding, which may be the same, but of this we have no proof. There are two varieties of the Tokay which are given in Maro's list, under no other designation than the numbers they bear in the Luxembourg and Montpellier collections. They are, "No. 22, White Grape, (56, 2, or No. 56 of the 2nd or Luxembourg collection, misnamed Chasselas Violet in the catalogue). A remarkably sweet, juicy, thin skinned, delicately flavoured grape, to my taste the best table grape in the colony, not in the least resembling the family of Chasselas in its habit, moderately productive, but uncertain, the flowers being apt to become abortive. Fruit very apt to rot, if heavy rain falls near the period of maturity, makes a delicately flavoured summer wine." This grape bears with us

the same character as that just given, and is held in higher estimation than in New South Wales, being little exposed in this colony to the risk of rain at the time of ripening. The other variety, known also by the same name in this colony, is signified "No. 23, White Grape, (295, 3, or 295 of the Montpellier collection.) An excellent grape for wine of medium strength, but much more productive." It is said to be less liable to injury from rain, and also to be later in coming into leaf than the preceding; but in this colony these distinctive peculiarities are not so marked, and the two have been classed together under the same name.

In dry warm localities these two vines ripen to a specific gravity of 112.5, and even higher, but are then apt, in fermenting, to stop short of perfect attenuation, and make a wine which is hazardous to keep. In general a more satisfactory result is obtained by taking them earlier, when a lighter and fully attenuated wine is obtained. A specific gravity of 108 or 109 has given the most satisfactory results when these grapes were fermented alone. In cold situations they would probably yield a superior wine, though their specific gravity were even below this. In one particular the Tokays have an advantage over all the kinds already enumerated; they require no stakes or supports of any kind. They are pruned to very short spurs, and throw out strong and vigorous shoots which bear themselves up with sufficient strength to carry a great weight of grapes. They are good steady bearers, and perhaps the most delicate of any grown for the table; too delicate to bear transporting, and consequently, are no favorites with the market gardener. They would, probably, bear well and ripen sufficiently on the south coast of Victoria, and are well worthy the attention of the wine growers at Barraboo. The Tokay requires more room than the preceding varieties, four feet by six has been found sufficient in this colony.

Shepherd's Grape, or Large Reisling, "a variety," according to Mr. Carmichael, "whose colonial history is well known, but of which the origin is not ascertained, although generally supposed to have been derived from the larger Reisling of the Rhine." According to the same, it is "by far the most prolific, and, at the same time, the most hardy variety" grown at Porphyry vineyard. It is also largely cultivated at Irrawang, and is there described as a "hardy vine, well suited to the climate, a good bearer, fruit sweet and high flavoured, and rather of a small size." At Camerallyn, it is said to be most productive, has never failed, and makes a wine of good body, although rather wanting in flavour.

In this colony the Shepherd's Grape has not been found equal to the character it has acquired in New South Wales, and is not cultivated in consequence.

At Caerwarra, on the Paterson, New South Wales, there are two of the Hermitage grapes which are found to suit the climate and soil, a light sandy allusium; these are the

Marsanne and Roussanne, or White Hermitage. This last, probably the same as the Roussette, is said, by Dr. Lindeman, to yield a full bodied wine. According to Mr. Blake, it is a good bearer and gives a wine of high character, but is apt to ripen unequally on the bunch. It attains a specific gravity of about 113.3. These are said to be the only two white grapes grown at the Hermitage, and by Mr. Busby's account, "the Marsanne yields a must, which, by itself, would give a sweet wine, while the must of the Roussette yields a dry wine. The wines known as White Hermitage, are more or less sweet, according to the proportion of sweet and dry grapes which have been united in producing them, for they are all made from these two varieties."

White Grenache is another variety cultivated in New South Wales; it is described as a large bearer, but apt to rot with rain; the wine delicate and fine. There is a grape of the same name grown in the south of France. According to the French authorities it produces a wine, which, when kept for ten or twelve years, receives the name of Rancio, one of the best liqueur wines known.

White Seyras is also grown in New South Wales, and is said to thrive well on all soils; the bunches are large, shouldered, and open; it bears largely, as much as 30 lb. on a vine, in rich soils, but ripens late, and is, consequently, fitted for the warmer localities. None of these four last varieties are cultivated in Adelaide.

Gouais, La Folle, known as the Brandy Grape, is one of the largest bearers known, and has yielded as much as from 1,200 to 1,300 gallons to the acre. The wine is light, thin, and spirituous; from its containing a very large proportion of the fermenting principles, it is useful in promoting the fermentation of other sorts deficient in that particular. When fermented alone it thoroughly attenuates, and contains about fourteen or fifteen per cent of spirit, the specific gravity of the must being probably 107. At this rate an acre would produce 150 gallons of spirit, (92.3). The following is also used for brandy in France, and, in some places, Sir William Macarthur found it more largely cultivated for this purpose than the Gouais.

Aucarot, a large bearer in ordinary soil, and produces a light spirituous wine of medium quality, and may be used like the Gouais, to promote the fermentation of other sorts. This variety, as well as the Gouais, when grown in rich soils, require long pruning and considerable trellis room for the abundant foliage.

Of all the white wine grapes grown in these colonies, there is none at all to compare with the Verdeilho. With the wine growers of New South Wales it has always been held in the highest esteem, and in Adelaide it has maintained an equally high character; and even when brought in competition with the choicest kinds from Spain and elsewhere, it still stands facile princeps; the best white wine grape in these colonies. It is thus described by Maro:

"Verdeilho or Madeira.— Imported in 1825, by the Australian Agricultural Company. Small oblong or oval white grape. This, all its qualities considered, is the most valuable grape for wine we have hitherto proved in the colony. It produces with tolerable certainty, and more abundantly than any of the varieties of the Pineau. Its crops may be estimated at from 300 to 500 gallons, and sometimes even 700 gallons to the acre. The wine, rich and generous, evidently capable of being kept for a great number of years. It, however, does not appear to become fit for use until past its fourth year, and even then it improves greatly with age. The bunches are small, the berries small and oval, and generally very thinly set on the bunch. They seem to suffer little, either from excessive heat or long continued rains. The whole of the skin of the berry will sometimes perish, without the slightest damage to the pulp. They, besides, ripen more equally than the grapes of almost any other variety we have. It is liable to have its young shoots broken off during high winds, through their extreme tenderness or brittleness; and violent winds or rains, during the flowering, cause a large proportion of the blossoms to become abortive. These are the only accidents to which it seems to be liable; in other respects it is a hardy variety, and begins to bear early; requires less room than the varieties of Pineau, say four feet by three feet."

In our drier climate it does not generally bear so well as in New South Wales, except in some favoured spots where the soil is very deep and abundantly supplied with moisture. In such situations, it not only bears large crops, but the fruit is superior in quality to that grown in drier soils. At Felix Stowe, on the Torrens, the vineyard was flooded the preceding winter, and this year, 1860, the crop of Verdeilho was the largest ever grown there, probably 800 gallons, and the specific gravity of the must 114.1. While the preceding year, when the vineyard was not flooded, the crop was much smaller and the specific gravity lower, being only 113.4. This last peculiarity we have already referred to as the result of growing the finer varieties on rich and fertile soils in warm climates. We have already alluded to the deficiency of ferment in the Verdeilho, which causes it to stop short in its fermentation before it attains perfect attenuation, and the necessity there is for mixing with it some of those grapes, such as the Gouais, which contain a considerable portion of ferment. In warm dry situations, when it yields a poor crop as to quantity, the resulting wine has turned out of the highest quality occasionally, and sometimes, though very rarely, the best perhaps grown in these colonies; but other vintages have given a wretched wine from the same vines, under circumstances as to climate and mode of fermenting no way differing from those which produced the good wines. Regarding the causes of this, we are quite in the dark, in fact we have much to learn of the peculiarities of the Verdeilho, and it is only by extensive and careful observations of wine growers in various localities, that we can arrive at satisfactory information on the subject. In more moist situations, the wine produced by the Verdeilho bears a more steady character year by year, although it never attains the very high flavour of the wine occasionally grown on average soils. In all situations the Verdeilho is certainly the highest flavoured of all our white wines; but there is one objection urged against it, and, with some reason perhaps, that it is too fiery

and spirituous, and deficient in body and fulness for so strong a wine. How far this may be obviated by a judicious mixture with some other sorts, such as the Sherry Grapes, remains to be proved. It would also be advisable to try the effect of fermenting at lower temperatures. We have already mentioned the favourable results of fermenting in casks on their bilge with the bung closed.

The pruning required by the Verdeilho depends in a great measure on the soil. In rich ground, it will be found necessary to leave rods of considerable length, but on ordinary soils, two or three short thighs of six or eight buds or eyes will generally be sufficient. From the mode of its growth, the Verdeilho also requires support; the shoots being too long and slender to support their own weight.

Of the red wine grapes of this division, the most important perhaps, and which was expected by Maro to turn out as valuable for red wine as the Verdeilho for white, is the

Seyras or Black Hermitage. This grape has fully realized the expectations formed of it. This is the sort said to be chiefly cultivated at the Hill of the Hermitage. It is a particularly hardy and healthy plant, but is not suited for the drier parts of this colony, where it bears poorly. In the more moist climate of New South Wales it bears well, and in deep black sandy loam in this colony, it also produces large crops. In the vicinity of the Barrosa ranges it is an especial favourite; and at Evandale, in that district, it has produced some of the best wines of its class, in these colonies. It requires rather long pruning. The distance at which this and other sorts are planted at Adelaide, is much greater than that recommended in Maro's letters; and the tendency is now to extend the distance still more; of course this is dependent on soil and climate. The other grapes of this division are the proper Claret grapes, the chief of which may be reckoned the

Carbinet Sauvignon. Is said to bear well in New South Wales, but is unsuited to this colony, except perhaps in the colder districts.

In the Médoc it is esteemed the best as to quality, of all the grapes cultivated for red wine, and should, no doubt, be equally suited to the colder portions of this continent. It is known by various names in France, and there seems to be two varieties cultivated there, and it is difficult to say which of the two we have in this colony.

The following description of the Claret grapes is from "Bordeaux, its Wines, and the Claret country." By C. Cocks, B.L. (London, Longman, 1846.):

"About a dozen different species of red wines are cultivated in Médoc; of which the following are the most famous:

"1. Carmenet, or Petite Vidure, has smooth leaves, slightly dentated; its berries are round, middling sized, and not very close together, of a brilliant and rather dark colour. It produces a fine, light, agreeable, and perfumed wine, of a clear colour.

"2. Carmenere, or Grosse Vidure, called also Grand Carmenet, Carbonet, or Sauvignon, has larger berries than the former; its bunches also, are both longer and larger; its grapes are of a bright colour, and exquisite taste, but subject to the couture or blight. Its produce is of the same quality as that of the Carmenet, but of a deeper colour. These two species are almost the only ones grown on certain privileged estates.

"3. Petit Verdot and Gros Verdot, have the same qualities, only the berries of the latter are larger; their leaves are of a dull pale green, and plentifully furnished with tendrils; their bunches short, and composed of small grapes of a bright red colour, and delicate taste, but which are slow in ripening; they produce a firm, perfumed wine, of a splendid colour, which keeps well.

"4. Malbec, or Noir de Pressac, is known by its long bunches and oval grapes, very dark and wide apart; its leaf smooth, large, and round, grows red in September; its wood is of a greyish colour. This vine is subject to the couture. It produces abundantly, a very ripe wine of little strength, but of a fine colour, which becomes delicate as it grows old, but which is inclined to turn acid if not properly attended to and kept in a fresh cellar."

In this colony the Malbec is a precarious bearer, and doubts are sometimes entertained of the genuineness of the plant known here by the same name, but no one, acquainted with the vine, can hesitate, after reading the above description, in pronouncing the Malbec of these colonies to be identical with that of the Médoc.

Mr. Cocks follows up the descriptions of the chief varieties with these remarks:

"These four species of vines abound in the most valuable estates of Médoc, where we also occasionally meet with the Tarney, which ripens quickly; and produces a wine of a ruby colour; its grapes are black and have a fine skin; its leaves are smooth and triloed, and its wood weak and straggling. The other less important vines are, the Merlot, a vigorous plant, with fine velvet black grapes, which ripen early, and produce a wine which is excellent when mixed with the

Verdot or the Carmenet. The Mancin, of a brown wood, and producing large, round grapes, which give plenty of wine of an inferior quality. The Teinturier, with reddish leaves, white underneath, round close grapes, short bunch of a very dark colour, but which has a disagreeable taste of the soil; the Peloulle, known by large, pale coloured grapes and bunches, a whitish leaf, with much wood and tendrils, gives a common, flat, and colourless wine; the Petite Chalosse Noire, with very large oblong grapes and very big bunches, used for dessert, produces a common, flat, but durable wine of a fine colour; the Cruchinet, the grapes of which are round, pulpy, and of an agreeable taste, forming fine large bunches, yield but common wine, which, however, keeps well; the Cioutat, remarkable only for its parsley-shaped leaves; the Pied de Perdrix, of brown wood, with long bunches of loose grapes, which have an agreeable taste, but produce only common wine; and, lastly, the Balouzat, of red wood, with large round grapes, which ripen quickly, and are agreeable to the palate, yields abundantly a middling wine of some body and a dark colour, with a peculiar, but not disagreeable, taste of the soil. Several proprietors have used plants from Hermitage; but the change does not seem to have made any advantageous alteration in the quality of the produce."

The chief objection that will be made to the Claret grapes is, the smallness of their produce. In France, the quantity in the best vineyards of the Médoc is very small indeed; and, probably, does not average above 120 gallons to the acre.

At Margaux is grown the most esteemed wine in the district, but the quantity is even below the average just stated. "At the Chateau," says Cocks, "they make on an average, (from 216 acres of ground), about a hundred tons of wine, of which eighty are of the best quality, and the rest is allotted to the second class." That these grapes will produce larger crops than in France, in favourable soils of this continent, has been already proved; but the quality of the produce is completely altered when they have been grown in this colony. The specific gravity of the must is so high (generally 111 and 112), that they are removed from the class of Claret wines to that of the strong wines of Spain and Portugal; and they possess so little advantage in point of quality, over the wines produced by the more luxuriant and large bearing vines of the south of Europe, that they are now very partially cultivated in the warmer districts. In the cooler climate of the south coast of Victoria, they are likely to do well in good soils and sheltered spots, and would greatly improve the quality of the Burgundy and Miller's Burgundy. They require great depth of soil, and ought to be pruned in good soil with short thighs for bearing wood. They also require support.

Besides the vines already enumerated, there are many others cultivated both in these colonies and in Europe, which make a poor wine, but are esteemed for their productiveness; such are the Gamay, cultivated in the inferior vineyards in France, and the Chasselas in these colonies. The coarse varieties introduced into this colony from the Cape of Good Hope, have, fortunately, been discarded. The Muscats, which, from their time of ripening, ought to be included in this division, we shall leave to the last, as these are chiefly used for sweet wines.

THIRD DIVISION.

This last division, comprising the varieties which ripen latest, is one of which we have had the least experience in these colonies. The late ripening grapes being unsuited to the climate of New South Wales, were little attended to, and it was left to the wine growers of this colony to work out their own experience with these late varieties; and they are only now becoming fully aware of the fitness of these late grapes for this colony, and of the unsuitableness of its warm climate to the vines of the colder wine districts of Europe. It was many years before we understood the difference between the climate of Adelaide and that of New South Wales; and we were inclined, at first, to lean too much on the experience of the elder colony in the choice of vines for wine making.

The extent of country whose climate is fitted for these later varieties, is, probably, greater than that suited to the earlier kinds; and this last may therefore be said to be by far the most important division of the three. In all that extensive territory to the west of the great mountain chain of New South Wales, which constitutes the water-shed of these mountains on that side, the climate and the soil are admirably adapted to bring to perfection the grapes of the warmest portions of Europe. The essays already made in vine culture, and wine making, at Albury, and other localities on the Murray and its tributaries, have given results which hold out the expectation of that large district becoming one of the greatest wine countries in the world. From the time of their vintage, and the specific gravity which their grapes attain, there is every inducement for the wine growers to cultivate the more prolific varieties of Spain and Portugal. Where grapes have a saccharine richness, as the following: Tinta, 114.1; Roland, 112.3; Miller's Burgundy, 112.1; Carbinet Sauvignon, 111.2; and this, too, so early as the beginning of March, it is quite certain that the soil and situation are adapted to grow vines of a much more vigorous and productive kind than have hitherto been generally cultivated at Albury and the Upper Murray.

In Maro's letters this last division comprises the red varieties, known as the Roussillon, which ripen imperfectly in all except the warmest situations on the east coast of New South Wales. They are the Carignan, Grenache, and Mataro; brought from Europe by Mr. Busby, and forming part of his private collection. These varieties have each distinctive features, and possess individual peculiarities which make it advisable to combine them; each has some desirable quality in which the others are deficient, and in this colony it has been found best to ferment them together, as is done in Europe.

Carignan is a hardy vine, of large vigorous growth, having wood of a rather dark colour; the leaves are large, rough, and uneven on the upper surface, and become of a deep red colour soon after the ripening of the fruit. The bunches are large, and the berries slightly oval, and what the French term tasses or cupped,

that is pressed into each other. When fully ripe they have a sweet astringent taste of a peculiar kind. This grape also goes by the name of the Black Portugal. Some believe the Carignan and Black Portugal to be distinct. The difference between them, however, is so slight as not to be easily detected; they have, therefore, been considered identical by most of our wine growers. Whether it is the same that is cultivated on the Douro, and from which the Port wine is made, is not positively known; it corresponds with the descriptions given of that grape, and ripens in this colony to a degree of saccharine richness which produces a generous, sweet wine.

Grenache red, a strong, hardy vine; wood of a light colour and short joints; the leaves, of a light green with a smooth shining surface, turning yellow in autumn. The bunches are short and thick, and the berries have a bluish hue and fine bloom; the stalks very green and coarse. The Grenache, like the Gouais and Aucarot, is remarkable for its very violent fermentation and complete attenuation; it goes all to spirit, and makes a strong but thin and rather poor wine, from its want of astringency; it is of particular value in promoting the fermentation of the other varieties.

Mataro, said to be the surest bearer of the three, is equally strong and hardy in its mode of growth, and remarkable for coming in leaf much later than the other two varieties, but ripening its fruit at the same time with them. It is not so astringent as the Carignan, but rich in saccharine matter and colouring principle.

The Mataro is known by a variety of names in these colonies: Espan noir, Espanor, Black Spanish; and the Lambrusquat, so highly recommended to the attention of the members of the Hunter River Vineyard Association, by the late Mr. King of Irrawang, appears also identical with the Mataro.

Along with these three, we sometimes find classed the Mourastel, which so much resembles the Mataro, that they are generally considered, in this colony, to be the same.

The Mataro, under various names, is said to be now largely cultivated in the south of France, to make up bulk in the red wines; and, from our experience of the vine, it is admirably suited for the purpose. It has no harshness or peculiar flavour to interfere with that of the finer kinds with which it is to be combined. At the time when the Claret grapes have attained perfect maturity, the Mataro has a specific gravity of 107 or 108. This is far from its perfect maturity, and the colour is not perfectly developed at this stage; but this may be remedied, as already pointed out, by exposing the grapes to the sun for one or two days after gathering; in this way not only is the colour developed, but the qualities of the grape, for wine making, are greatly enhanced. After such exposure, the grapes must be allowed to cool before being crushed. In situations suited to the growth

of the Claret varieties in these colonies, the Mataro might be grown along with them to give quantity. It is certainly better fitted for this than the Grenache or Carignan.

To the wine grower, these Roussillon kinds possess a great advantage over most others, in this, that they require no supports; the shoots, rising upright from the stem, bend gracefully all round, and form, with their thick foliage, sufficient shelter to the fruit. They are all large steady bearers, and the fruit is not liable to any injury from rain,—nor are the blossoms apt to be rendered abortive by high winds. They require pruning to very short spurs.

The only white grape included in this last division, in Maro's letters, is the

Blanquette; it is much cultivated in the south of France, on the Mediterranean coast, and deserves the attention of wine growers in these colonies. We have the following notice of this grape, by Redding: "The greater part of the other white wines is made from a species of grape called Blanquette, which is picked out at the vintage from the red fruit with which it is mingled. Rivesaltes furnishes most of these wines. The vintage is completed at one, and not, as with the Muscadine grape, at two pickings. Some growers leave the whole, with the stems and skins, to ferment twenty-four hours in the vat. There are two qualities of these wines, one dry, and the other luscious. The same grape produces both, the soil alone causes the difference. The soils, abounding in stone and quarts, such as St. Cyprian, Pauissac, and Lejas at Rivesaltes, give the luscious white wine. The soils, purely argillaceous, or calcarious, yield the dry. As the last kind is little in demand, they try to obtain a luscious wine from the Blanquette grape, which is gathered when well ripened, and exposed on the warm earth to the full action of the sun for ten or twelve days. Eight hundred hectares, planted with the Blanquette, each produce about twelve hectolitres of wine." This is a small quantity, being little more than a hundred gallons to the acre; but it ought to be borne in mind, that the land selected for vineyards in the provinces of Languidoe and Provence, is generally the poorest, and that it seldom receives any preparation before planting. In describing the vineyard near Collioure and Perpignan, Mr. Busby says, "In planting these hills they break up the ground only to the depth of eight inches, and as they take out a great number of stones, the depth of the soil remaining is not more than six inches. They then bore a hole in the loose rock with a bar of iron, and thrust in the plant to a depth of twelve or fifteen inches."

The white grapes of the south of Spain, the best of which were selected and brought to Sydney, by Mr. Busby, seem to have been set aside as unsuited to the climate of New South Wales. The warmer climate of Adelaide and the Murray country, would ripen to perfection these varieties; and, from the more favourable weather at time of ripening, they are likely to yield a superior wine in these colonies, to those produced in the Peninsula, where the wet weather, which often prevails in autumn, greatly injures the quality of the wine.

The varieties imported into Adelaide from Spain, were selected as the best grown in the Sherry country. One of these selections was procured for the writer by the late Mr. James Wilson, of Xeres, from the famous vineyard of Domecq, at Macharnudo, and consists of the following varieties:

Mantuo Castellano is thus described, (grape large, nearly round, dark green, fleshy and very lickerish, skin fine, ripen late). This is a hardy vine, sending out strong straight branches in all directions, upright, horizontal, and even inclined downwards, and therefore requiring a stem of considerable length—15 or 18 inches at least. The wood is of a yellow colour. The leaves large at the bottom of the shoots, and diminishing very much towards the extremity; they are also cottony on the under surface. The leaf stalk is of a clear red, and almost at right angles to the leaf. The must of this grape, according to the Spanish authority, Simon Roxas Clemente, "marked at San Lucar, on the 15th September, 9 degrees; and on the 19th of the same month, 9 of Beaumé's hydrometer, or 106.4 and 106.9 sp. gr." This, we consider, low in this colony.

Albillo Castellano, (grape green, middling size, very soft, juicy and sweet, skin thick, ripen early). This vine, in its mode of growth, is somewhat similar to the former, but the branches are more slender, and it is by no means so productive.

Perruno, (grape rather yellowish, large, round, very obtuse, very transparent, sourish taste, ripen late). This is also a healthy vine and likely to prove a good wine grape.

Cano caso, (grape large, gilded, sweetish, skin fine, ripen early). This is an exceedingly strong and productive vine, and in its mode of growth, as well as the two preceding, is adapted to be self-supporting, as in Spain. Neither of these three is mentioned by Mr. Busby.

Palomino, (grape round, white and hard, transparent, skin fine, ripen early). This is supposed to be the grape which Mr. Busby, having lost its name, inserted in his catalogue as the Macharnudo. This vine, in its mode of growth and general form, resembles the common sweet water. If there is any difference between them it is in the fruit of the Palomino being more fleshy. From its mode of growth this vine requires support, and may be pruned, when grown in good soil, to thighs. The Palomino is said to be largely cultivated in the districts where the Amontillado is most frequently produced. The subject has been alluded to in the previous chapter.

The three following, of the same collection, produce sweet wines:

Pedro Ximenes, (grape white, rather gilded, very obtuse, soft, little fleshy, extremely sweet, skin very fine). This is a very hardy vine, and produces well; the berries are large and oval, on an elongated loose bunch, and ripen pretty early in this climate. The shoots are strong and vigourous, standing erect, and requiring no supports. To the description of the vine, by Clemente, are appended the following observations:

"The specific gravity of the must of this grape was, on the 15th September, at San Lucar, after two days exposure to the sun before pressing, 12 degrees of Beaumé's hydrometer, which is equal to 109.2. And at Pairette, on the 2nd October, its must, after four days exposure, weighed 16 degrees, or 112.1. This grape rots more readily than any other variety, as it is much attacked by bees and wasps, in consequence of its extreme sweetness and the fineness of its skin. Its must is considered the most precious either for sweet or dry wines, and it enters largely into the composition of all the most valuable wines of the south of Spain. It is not esteemed for Brandy. This variety is said to have been originally transplanted from Madeira and the Canaries to the banks of the Rhine and Moselle, and thence by Pedro Ximenes to Malaga, two centuries ago. At Malaga and Grenada, one-half of the plants in the vineyards consist of this variety; at Xeres, one-eighth; at Motril, four-fifths; and Paxarette, one-fourth."

Moscatel Menudo Blanco, (grape small, round, gilded, very obtuse, soft, little fleshy, extremely sweet, skin very fine). This grape corresponds with our Muscat blanc. It is by far the most delicate of all these just enumerated. The branches are long and thin, and require support; the foliage open, and not affording sufficient shelter to the fruit, which is, consequently, apt to be scorched.

Moscatel Gordo blanco, (grape large, white, a little gilded, harder than the preceding, less sweet, ripens later, and skin thicker). This grape corresponds with the Muscat of Alexandria, the Muscatel raisin grape. It is much more hardy than the preceding, but requires support also. "The must of this grape, at Chipiona, weighed on the 15th September, after three days' exposure to the sun, 12 degrees, or 108.9. At Palmosa, on the 26th of the same month, it weighed 13 degrees, or 109.6. In October, 1808, it weighed 15 degrees or 111.4."

Nothing appears so remarkable to those who have had experience in wine growing in this colony, as the low specific gravity of the grapes as above given, in Spain. At the corresponding season in Australia, the middle of March, the Muscats give a specific gravity of 112.0, 112.8, and 113.2, in successive years; and if allowed to remain to the first of April, they will ripen to 114.0 and upwards, and this too, when the must tried has been obtained by simple crushing, and not, as in Spain, by strong pressure, by which a more impassiated and heavier juice is obtained. The specific gravity, as given in the description of wine making at Xeres, in the appendix, is—

Dry wines, from 110.1 to 111.7

Moscatel, sweet, 114.0 to 116.0

Pedro Ximenes, sweet, 113.0 to 116.0

But the dry wines produced in the neighbourhood are only 107.5 and 108.3. Where sweet wines are made in colder climates, as at Rivesalts, in the South of France, they obtain the saccharine richness required, by the following means: "The grapes are allowed to hang upon the vines till they are so ripe that they begin to shrink; they are then cut, and left on the ground, under the vines, where they grew, for eight or ten days, unless the weather should prove unfavourable, after which they are pressed, and the juice is put into a cask, leaving the bung out." When the wine is drawn off into another cask, about a month after, the process of sulphuring is not employed, but a piece of brown paper, steeped in strong brandy, is burned instead. From the difficulty of obtaining sufficient maturity of these grapes for the making of sweet wines, it is customary, in many places, to supply the deficiency of saccharine matter by a considerable addition of strong spirit.

Along with the White Muscat, and Muscat of Alexandria, may be enumerated the red and black varieties, only suited for sweet wines—the flavour being too coarse for dry wines.

There are other collections of Spanish vines in Adelaide, besides that just described, as obtained from Domecq's vineyard, and which comprise several other varieties. That sent to the colony by M. Leigh, contains some of those mentioned by various writers as favourites in Spain; of these are the

Belas blanco.—This seems to be a good vine and produces well.

Doradilla, or, according to Sir T. L. Mitchell, Jaen Doradilla, (or gilt), receives its name from the gilt appearance of its grapes. This is a good, healthy, and productive vine, and has obtained in this colony the name of Leather Jacket, from the toughness of its skin.

Uva de Rey, mentioned by Busby and others, as largely grown, is thus described by Roxas Clemente: "Stock large. Branches few, horizontal, middling or rather small, round, reddish grey, &c. Leaves rather small, rather irregular, generally entire, &c. Bunches large, irregular, composed of small compound bunches in the upper part and simple bunches towards the end. Berries white, rather hard, sweet but rather harsh and rough."

There seems to be great uncertainty in Spain, as elsewhere, about the names of the different varieties; the same vine being known under various appellations. The great antiquity of many of these varieties has probably conducted to this complexity. Sir T. L. Mitchell thus describes one of the kinds which he enumerates:

"Tempranas, (early); of this there are white and black grapes, &c. They are called early, because they are the first to ripen. Pliny called them Farenses, because becoming ripe so early, they were better known and sold better in the market place near the Forum. Others called them Albanas, the name by which they are mentioned in Horace."

A satisfactory knowledge of the varieties cultivated in Spain, we cannot hope to arrive at, until we have a collection of vines made, and carefully attended to in these colonies; and this cannot be commenced too soon, if the vine is to assume, among our permanent sources of wealth, the position to which it is adapted by our soil and climate. We cannot judge of the quality of the Spanish grapes, of which one hundred and twenty varieties are described by Roxas Clemente, by the results as we see them in Spanish wines. Vine cultivation and wine making, in that unfortunate land, are as far behind as every other branch of industry. "If France," says Redding, "rank before Spain in this respect, it is because science has led the way to excellence, and has enabled the French to attain, by delicacy of management, by art and labour, that which nature had well nigh awarded to Spain without such appliances."

"The wines of Spain are grown on a soil most congenial to the culture of the vine. The sun ripens the grape without those hazards from chill and humidity to which, in a more northern climate, the vintage is constantly exposed. Hence the crop rarely fails; though in the southern parts of the country the heat is so intense in summer, that they are obliged to irrigate the vines. From north to south, sites, soils, and exposures of the happiest kind cover the face of the country." Not more happy or more numerous than are to be found in the southern parts of this continent, which will, one day, and that not a distant one, become a land of corn, wine, and oil; truly Australia Felix.

APPENDIX I.

TRENCHING AND TERRACING.

(From Maro's Letters on the Cultivation of the Vine.)

SUPPOSING the site to have been selected comprising the various requisites according to the object the cultivator has in view, I purpose, in this paper, to explain what steps seem best calculated to promote the successful formation of the vineyard, at the least ultimate expense. I shall first describe the method I consider preferable in situations which are level or of gentle inclination (where the fall does not exceed one foot in twelve or fifteen for instance), because, in such situations, no preliminary levelling for the terraces will be necessary.

Should the site occupy one of those deep dry banks of sandy alluvium, such as in a preceding paper, under the head of SOIL, I have mentioned as common on the banks of the rivers Hawkesbury, Nepean, &c., nothing appears requisite but to trench to the depth of two or three feet; and should the vineyard be of any extent, to mark out roads or alleys wide enough for carts to pass completely round the area, but within the enclosing fence, and to intersect it at convenient distances. If, as an example, we suppose this area to comprise 15 or 20 acres in the form of a parallelogram, it will be expedient to divide it by means of these intersecting alleys into strips not exceeding 80 to 100 or 120 yards in breadth, by about double that length. The rows of vines being afterwards planted across the breadth of the strips, carts may thus be brought to receive the grapes during the vintage, and to deposit manure opposite to the end of each row, and within 50 or 60 yards of any part of it. Attention to this precaution in laying out a vineyard of any considerable extent will occasion a very material saving of labour in its subsequent management.

Should the site be upon what is, in the colony, usually termed "Forest land," where the inclination of surface will probably be greater, and an equal degree of porousness or permeability in the subsoil rarely or never to be met with, it will be advisable to take precautions to prevent the superfluous waters, which are poured down during heavy rains, from doing mischief. To this end, any little hollows or water courses, or, at all events, the lines along which the surface waters can most readily be made to flow, should be chosen for the alleys or cartways, sacrificing to this object that regularity, which in a plain surface, or soil of the description mentioned in the last paragraph, would be desirable. The position of the alleys having been determined upon, a drain, two feet wide at bottom, should be opened down the centre of each, and twelve or eighteen inches below the depth of the proposed trenching. What that depth should be must depend upon circumstances, and if the ground should not have been sufficiently well examined previously, may, now that the drains are opened, be decided upon. Should the surface soil prove to be of a friable nature, with a loose open subsoil, offering no impediment to the roots of the vines for the depth of a yard or two, two feet may suffice; but, in all cases, I should advise this to be considered as the minimum depth; if, however, the subsoil should be clay intermingled with stone, or clay resting upon shale or some other rock, soft and frangible when turned up, but lying, as is frequently the case, in tolerably compact layers until stirred, three feet, or three feet six, may be advisable. Whatever depth then may be adopted, the drains having been opened to a foot or eighteen inches below it, are to be filled up again as the trenching is proceeded with, to within twelve or fifteen inches of the top, with any large stones which may be turned up during the progress of the work; or, should these be wanting, with logs of hard wood, smaller pieces or brushwood being placed

above; in either case to be ultimately covered with a few inches of soil or gravel to form the road way.

Secure hollow drains for any superfluous water, which may percolate after long continued heavy rains, having thus been constructed, whilst the alleys also are intended to serve as channels for the surface water, the trenching of any intermediate strip of ground may be proceeded with. For this purpose it will be most convenient to commence at the lowest part of the ground and there to open a trench three feet wide, extending across the strip from alley to alley, quite to the edge of the drains, reserving the material thrown out from the excavation to fill up the last trench at the top of the strip, or any inequalities of surface. Then to mark out another trench of equal width, and with its contents to fill up the one first opened, taking care to place the turf and surface mould at bottom, the clay intermingled as much as possible with a portion of the stone next, and the lowest stratum, presumed to be the most stony or gravelly, at top.

There are several reasons, in addition to its being really the easiest method, for reversing the natural position of the different strata. First, by throwing all the turf and surface mould to the bottom, the vine is at once encouraged to strike its roots deeply where they will be supplied with the most abundant nourishment, and become least liable to suffer from the vicissitudes of the seasons, whilst the seeds of all weeds and plants, the growth of which would be pernicious, by being buried so deep are prevented from vegetating. Next, a sufficient quantity of the stony or gravelly material having been mixed with the clay to keep it "open," the remainder should be placed to form the surface, because it is less liable to favour the growth of weeds, it more readily absorbs all the rain which falls, until the ground is saturated, it neither cracks in dry weather, nor becomes miry during rain, it tends to preserve a more uniform temperature and state of moisture in the soil below, and finally, becomes of material use at the period of the maturation of the crop, by increasing the mean temperature, in absorbing heat during the day, and radiating it upwards throughout the night, and by preventing the bunches of grapes which hang low from being splashed with dirt when it rains. The first trench having been filled up, a third may be thrown into the second, and so on until the area between any two of the alleys is finished.

I do not consider it advisable to reduce the ground too minutely, a certain portion of lumps of two or three inches diameter being advantageous. They increase the permeability of the soil, and are useful in giving out the moisture they absorb during rains more slowly than the finely pulverised soil. In dry seasons, I may observe, most plants will retain their freshness longer in a soil containing many lumps than where there are none. It is likewise proper to leave the surface of newly trenched ground as rough as possible, until the period for planting approaches, that a large portion may be exposed to the action of the atmosphere; and it is advantageous to have it so exposed for several months previously, that it may receive the autumn and winter rains, and settle down. This will be the means of preventing any after-settlement in the soil, which, as I propose that it should be formed into a series of flats or levels before it is planted, would occasion additional trouble. These flats, which may be made wider or narrower, according to the inclination of the ground, are intended to be supported by earthen banks, made firm by compression with the back of the spade, each terrace extending across the breadth of the strip, and having the

slightest possible inclination from the centre towards the alley or water channel on either hand.

Having explained the mode I consider best to adopt in trenching a slope of gentle inclination, in such a manner, I hope, as to render the subject intelligible to those persons who may not previously have been conversant with it, I shall now endeavour to show how an abrupt site may be effectually managed. [See Sketches Nos. I. and II.]

The alleys with their trenches, as in the former instance, should be marked out and opened (following the direction by which the water can be most easily conveyed out of the vineyard) to be afterwards filled up again with stone or timber, as the trenching is proceeded with; with this difference, however, that the more rapid the slope, the more broken and irregular the ground is, the nearer to each other these channels for the water will require to be formed. Where the descent is as much as one foot in four or five, I will assume from twenty-five to forty yards as a proper distance, unless, indeed, some considerable irregularity in the form of the ground should render it expedient to have them closer. In all cases where the slope exceeds one foot in seven or eight, the vineyard will probably be too steep to admit carts, the alleys may therefore be reduced to the width of mere water channels, not exceeding four or five feet. Even where the inclination is not too great for carts, it will not be necessary to form roads for them nearer to each other than eighty or one hundred yards, so that with a view to their free passage, part only of the alleys need be made of the requisite width. The alleys having been fixed upon, the intervening spaces should be carefully levelled, commencing at the bottom; or, in other words, the rate of ascent for any given distance should be accurately ascertained and noted down. For this purpose a good strong light carpenter's or stonemason's plumb-line level, and a quantity of pegs of hardwood should be provided. Battens inch square, and cut into convenient lengths, answer best for the last purpose. The object in levelling the ground at this stage of proceeding, is to mark out the area between any two of the alleys into convenient strips for terracing, as it is necessary that the width of the terraces with the height of the terrace walls should be fixed upon, previous to trenching the ground. As a general rule, I do not think it convenient to have the terrace walls more than two feet six inches high, and although they should not be put up until afterwards, I may here observe that they may be built in a very rough manner of almost any stones which may be turned up in trenching, and, providing that they do not exceed the height above mentioned, need not exceed eighteen inches wide at the bottom, tapering, or "battering," to about a foot at top. Assuming two feet six inches then as a convenient height for the walls, and four feet as the distance at which the rows of vines are to be planted from each other, the following are the spaces I should propose to allot for the terraces according to the inclination of the ground:

At an ascent of one foot in four (the most rapid activity I conceive any one will be likely to plant with the vine) I should mark out the terraces seventeen feet six inches wide: viz., sixteen feet for four rows of vines, and eighteen inches to be occupied by the terrace wall. In seventeen feet six inches, at one in four, the perpendicular fall will be rather more than four feet four inches. Of this, two feet six inches will be made up by the wall, whilst, by dividing the sixteen feet of

terrace into four smaller terraces, each supported by a bank of earth (made firm by compression) about seven inches high, every row of vines may be planted on a sight of its own, perfectly level, except a very slight inclination which may be given to it from the centre towards the alleys or water channels, which have been made perpendicular to them on either side.

If the rise be one foot in five, twenty-five feet six inches will be a convenient width for the terraces, viz.: twenty-four feet for six rows of vines, with a rise of six inches to each row, and eighteen inches for the wall. At one foot in six, thirty-three feet six inches may be allowed, the intermediate spaces being divided into four smaller terraces, each intended for two rows of vines, and supported by a bank eleven inches in height. At one in seven, forty-one feet six inches may be allowed for ten rows of vines, each double row occupying a level supported by a bank little more than ten inches in height. At one in eight, they may be of the same width, with a rise of eight inches to each little terrace of two rows; and so on, suiting the space between the terrace walls and the height of the little terraces to the inclination of the ground. At the inclination last mentioned, it will be very practicable to dispense with the walls altogether (by allowing six inches rise to every row, or twelve inches to every double row), although I should prefer their occasional adoption, if stone be at hand, until the slope diminishes to one in eleven or twelve feet. It must be remembered that few situations of rapid declivity exist in which stone for the walls will not be turned up in trenching, and that to form it into rough walls will frequently be the readiest mode for its disposal. If stone for the terrace wall be not readily procurable, sloping banks of earth turfed outside, may be substituted, observing simply that more room must be allowed for them, not less than one foot for every foot in height. Logs of wood piled upon each others, or split hardwood slabs, with their ends twelve or eighteen inches in the ground, may also be used.

The observant reader will, I trust, comprehend that the object in reducing a bank or hill into a series of levels is twofold, viz., the absorption of the greatest possible quantity of rain during periods of drought, which are not unfrequently broken by very heavy showers of short duration; and the safe conveyance out of the vineyard, by means of the channels which are supposed to have been formed at moderate intervals perpendicular to the rows of vines, of all superfluous water at times when the rain is in excess. In few words, to husband to the uttermost the moisture which falls when rain is deficient, and to prevent any damage when it is violent or of long continuance. None is to be allowed to escape directly down the hill from terrace to terrace.

I can testify from personal observation made in Europe, in an extensive district of vineyards, that the severest labour connected with their management, although the slopes they occupied were intersected by numerous terrace walls, consisted in the annual removal to the top of the enclosure, of the soil washed down by the rains to the bottom. In the district in question, and indeed generally throughout France, where they are subject to this disadvantage, I have little doubt they would gladly have obviated it by converting the inclined planes of their vineyards into a series of levels, were they not restrained by another consideration which does not operate with us. I mean the necessity which generally prevails to turn to the best account the degree of heat which the summer affords, and, with this view, to preserve the slope of the vineyard as nearly as possible perpendicular to

the meridian rays of the sun at the period of the year when their full influence is most required.

The position and height of the various terrace walls having been determined upon by the use of the level, they should be marked as the levelling is proceeded with, by driving to a secure depth pegs of hardwood, their tops being made to indicate the levels to which the summits of the terrace walls are to be carried. The area marked may then be trenched, care being taken, by leaving a shoulder of earth untrenched of ten or twelve inches diameter around each, that the pegs are not disturbed. It will only be requisite to do this in a very rough manner at first, as the terrace walls should not be built until the newly trenched ground has been settled down again by rain.

For the information of those who may not be conversant with manual operations of the kind, I may observe, that in tracing out a line of any considerable length, either upon a level or any angle of inclination, it is not necessary, unless the line be very winding, to use the levelling instrument throughout; but two or more pegs having been inserted at moderate distances, with their tops at the desired level (or angle of inclination, as the case may be), the remainder of the line may be produced by taking sights over them.

Although I so strongly advocate the formation of all slopes in this climate which are to be planted with the vine (or converted into gardens, orange orchards, &c.), into a series of level terraces, I am quite aware that situations exist in which vineyards with considerable declivity may be successfully managed without this preliminary expense. Those slopes which, after being trenched, have their surfaces entirely composed of stones, will of course not be likely to suffer nearly so much from the action of running water, and will absorb it much more rapidly than the situations where there are few or none. All I mean to insist upon is, that if, without any considerable additional outlay, the slope can in the first instance be properly terraced, its ultimate success will be rendered much more certain, and the outlay be amply repaid by more abundant crops and diminished expense in the cultivation.

The plan of adopting low terrace walls, even where the declivity is great, and reducing the intermediate spaces into a series of smaller levels, supported by banks of earth, is probably novel to the greater part of your readers, and may appear more troublesome and expensive than where higher walls and broader terraces are adopted. Although by the adoption of this plan, the use of the levelling instrument is much more frequently required, the actual labour of moving the soil is greatly diminished, not to mention the saving effected in the reduced height of the walls, and I can assure them, from personal experience, that the low banks of compressed earth which support the intermediate little terraces are neither troublesome to form, nor, being once settled for a few weeks, of a nature to require any particular care to keep them up. No water being permitted to flow over them from above, they are subject to very little wear and tear. I have some in view from six inches to fifteen inches high, which were formed five or six years ago, and although they have never since been touched, they continue to be in good preservation and fully to answer their purpose. Any annual repairs which these little banks might require would be of trifling consideration, compared with their utility; and with regard to the trouble of levelling, I may add, that two men, with a very little practice, will level and

mark out as much in one day as they can afterwards prepare for planting in a week. In conclusion I would observe, that the method I recommend demands neither additional trouble nor skill on the part of the workmen, but is rather calculated to diminish the former; but in rapid declivities and surfaces of broken irregular form, more attention and some little skill to turn them to the best account are required, on the part of him who directs their progress.

In the foregoing pages, I have minutely described the modes I should prefer to adopt, in preparing portions of land variously situated for planting with vines, being persuaded that the expenses incurred in trenching, &c., will ultimately be amply repaid by the more rapid progress of the vines, their greater productiveness, and probably in the superior quality of the wine. But although I so strongly advocate trenching, and trenching to a great depth, I do not wish to be understood that to form a vineyard at all, particularly in soils naturally loose and friable it is absolutely indispensable. I am aware that in some vineyards of celebrity, even in the warmer districts of France, it is little practised. The ground is merely ploughed or dug eight or nine inches deep, and at the planting, holes are made in the undisturbed subsoil fifteen or twenty inches deep, sometimes merely with an iron bar, in which the cuttings are inserted. Planted in this manner, the greater part of the cuttings strike root, but are said usually to make little progress for several years, and to require a much longer period, before they become sufficiently strong to produce a full crop, than they would have done had the ground been previously trenched. I am the more desirous to explain this, because I believe that many persons have been deterred from planting vineyards in consequence of the great preliminary outlay required to trench the ground, an expense which many are not in a condition to afford. To such I would say, rather than have no vineyard, if your soil be suitable, plant without trenching, inserting the cuttings fifteen or eighteen inches deep in holes made with a narrow spade, the ground having been previously prepared by ploughing, &c.

APPENDIX II.

WINE MAKING AT XERES.

In XERES the vintage generally begins in the middle of September, and continues to the latter end of October, and sometimes to the first week of November, choosing fine weather for gathering, and when there is no rain; but, should the season be rainy, then the farmer makes the best of it, and proceeds gathering as he can, when the grapes are mature; and in this case, particularly when the vine is less than ten or fifteen years of age, he assists the quality of the must, or new wine, with some boiled down wine, (the must boiled till it becomes like syrup), mixing it with the must previous to fermentation, with the view not to lose his vintage from the water which rests among the grapes, or their not getting to maturity through rain, or being deficient of saccharine from the want of dry weather, or enough of sun, (about two jars of this boiled wine,—the twenty-fourth part of a butt, forty-eight of these jars going to a butt,—is put to each butt of the must). The difference of size of the vineyards does not diminish or extend the period used in the gathering. A vineyard of ten acres takes as much time as one of fifty, because those grapes which are mature are first selected, and the rest left on the plant until they become mature. When the grapes are cut rather

greenish, or not sufficiently matured, they produce more wine, and of a paler colour something, but the wine has less substance, and is longer in getting to maturity, or to the condition which is wanted for exportation. This is the Mancanilla (the grape called Listan, is what gives this kind of wine in San Lucar,) wine, or the wines produced at San Lucar and Puerto Santa Maria, by that name, and is generally used for the consumption of the country, or in San Lucar they make coloured wine of it generally, but it takes a long time to ripen if intended for exporting.

Should the quantity of mature grapes collected at a time be insufficient to yield one or two butts of must, they are left exposed to the sun by day, and to the air by night, for one or more days, when fair weather permits it; the entire produce of the vines is, as gathered, treated in the same way, because the grapes acquire more saccharine matter by the exposure, and lose more or less of their greenness or immaturity, some parts of most of the bunches being generally in this condition more or less. The grapes are spread upon small round mats, and, thus exposed, less wine is produced from them, but the quality is better. A particular proprietor, after the grapes are thus exposed, has them all examined before they go to the press, and divested of all the bad grapes, the dirt which may be among them, leaves, &c., which might communicate a nauseous taste, and otherwise affect the quality of the wine. There are generally two pressings of the grapes observed by the Xeres wine makers; or, at least, two qualities of wine are produced from them. The press contains a sufficiency of grapes to yield a butt in all. The first pressing, or the must produced from it, is called yemas, (or the first fruits), and is performed as follows:—The grapes are all spread equally on the bottom of the press. Three or four men—having shoes on purpose full of nails—tread on them until all the liquid possible is got out of them. They are then piled up round the screw of the press, and tied about with small stripes of mat, about four inches width, from top to bottom, and screwed down by the force of two men to the screw, until all the juice is expressed from them; this, with what was abstracted by the foot, forms the yemas. The second pressing is called, Agua pies: the husks, or skins of the grapes are spread about the press, and a few jars of water thrown over them; they are then trodden upon by the men—not so long as before—a few turns only—and afterwards piled up about, and expressed by the screw in the same manner as was done the first pressing; they are twice afterwards, after being opened up and spread about in the press, put round the screw, sprinkling over them when piled, about three or four gallons of water each time; or, if it be intended to make brandy from the husks, this second pressing, as it is called, has only two operations instead of three; this is called Agua pies or Trasmorto. Sometimes they have a third pressing, when brandy is not intended to be made from the husks; this third pressing is called Esperiaca or last must, and is done precisely as the second was, and by two screw operations. With very dry seasons the Yemas turns out of an inferior quality to what fair average seasons give, and less in quantity considerably, but the Agua pies are better than with good seasons. Indeed it has been found in some vineyards this year, (1827), that the Agua pies were not much inferior to the Yemas, which I account for by the thickness the skin of the grapes acquire through the heat and drought, giving more saccharine principle to them that is disengaged by the influence of the water, and yields more and better liquor than in good temperate seasons.

Immediately after pressure the must is put into butts well cleaned, leaving a vacuum of about the fifteenth of a butt, in order that the fermentation, which commences immediately, may freely proceed without losing any of the wine; likewise, to save the wine which otherwise would still spill over the cask from the bung, an earthen, or other vessel of the form of a funnel is introduced into the bung-hole of the butt, and receives all the wine which is forced up by the violence of the fermentation, and returns it back again into the cask as the fermentation subsides. The must is kept on the lees till about February or March, the bung always open, and no means used from the beginning to stop or excite the fermentation. At this time, when the first or sensible fermentation is quite over, and the wine appears pretty clear, it should then be racked off the lees into other casks, well cleaned, and smoked a little with sulphur matches introduced at the bung hole, closing this on it. About the months of April or May again, when the second, or as it is called, first insensible fermentation is over, the wine is again racked off into other casks well cleaned, but without being sulphur smoked; and in September or October, when the heat of the summer has passed by, and the wine more settled and cool, the same operation is repeated for the third time. On every occasion of racking the wines off from the old butts, they should be properly examined, and if any of them are found to be weak or sickly, the casks in which they are to be put should have a jar of brandy (about 2½ gallons), put into them before the wine. Next spring the wine is again removed into fresh casks well cleaned, and the same remedy applied when needful, and afterwards kept at the discretion of the proprietor, it being now eighteen months old.

It may be observed, that all the places in the neighbourhood of Xeres, such as San Lucar, Puerto de Santa Maria, Bota, Chipiona, Treberguen, and Lebriga, &c., do not pay the same attention to the collection, selection, and cleaning of the grapes; they begin the vintage ten or fifteen days before the people of Xeres, and collect at once without regard to weather, maturity, &c., all their grapes. Their vintage only lasts eight or ten days, and is generally over when that of Xeres begins. These people look more to quantity than quality. The grapes thus early cut, and indiscriminately pressed, producing more wine.

The grapes should never be put to the press warm from the sun, but should be allowed to cool by the night air, and pressed in the morning; nor should the grapes be allowed to lie in the press any time untrodden, or over the night from one pressing to another.

On all grapes generally, whatever kind of seasons prevail—excepting rainy ones—a small quantity of water, more or less, according to the condition of the grapes from the seasons, sometimes only one jar and sometimes more, is put to each press-full, which produces about a butt of must; and on all occasions, and for all qualities of grapes, indiscriminately, about 4 lbs. of yeso, or quick lime, is strewed over them after the water is put on.

When the vintage season is rainy, very little or no water is needed for the Muscatel and Pedro Ximenes (sweet wines) grapes, and of course none on the dry wines, but about double the quantity of quick lime is put on the grapes to produce the effect of absorbing the superabundant water left among them after rain.

With respect to the sweet wines (Pedro Ximenes and Muscatel), when the grapes are considered properly matured, many of them are found dry, and consequently to contain little more than the saccharine, in which case three or four jars of water are applied to them with the usual quantity of quicklime, or yeso, say 4 lbs.

When the product of a vineyard, or of a certain part intended to be made up together, is to be pressed, the strength of the first butt of Muscatel should be tried by the Gluecometre de Chevalier, and if it turns out to have too great a quantity of saccharine, which will be seen by the number of degrees the instrument describes, a sufficient proportion of water should be applied to the rest of the grapes, in order to reduce it to that degree of strength which experience has shown to produce the best wine. It is better that the water used for this purpose should, if possible, be taken from the wells in the ground where the vines stand, in preference to any other water, as it partakes more or less of the nature of the soil and its production, but cistern or rain water is not good and should never be used.

Besides dry wines, Xeres produces some Muscatel and sweet wines.

The saccharine matter in all is influenced more or less by the seasons, and this has an effect upon the quality. Much always depends on an attentive and luxuriant cultivation of the plant and soil, whatever kind of seasons there may be. The best wines are got when the heat of the summer is progressive, and not extraordinarily warm at any time, and when rains for two or three days happen before the vintage begins, and then followed with a temperate heat and dry cloudy weather; such a year as this, the sweet wines are better in quality and greater in quantity, and the wines generally show more strength in the must. If the summer is unusually warm the maturity of the sweet grapes is precipitated, and in this case it has been observed that they weigh from one to one-and-a-half degrees less, by the Gluecometer, than in good temperate years.

Weight by Gluecometer, or Aerometer, of Baumé, of the must in fair years :

Muscatel, from 19 to 21 degrees.
Pedro Ximenes, or sweet, 18, 21
Dry wines in general, 14, 16

Or even the strength which the must, in good years, should have in Xeres, and to which it should be reduced by water, should the proof or trial butt exceed the highest mark.

But the dry wines that are produced in the neighbourhood, weigh only from ten to eleven degrees.

The more saccharine the wines have the greater the number of degrees the Gluecometer of Chevalier shows; but it would seem that twenty is the highest strength supposed to be proper for wines, as the index of this Gluecometer goes no higher. This Gluecometer, however, was for French wines.

The Muscatel, and other sweet wines, from their great quantity of saccharine matter, undergo much less fermentation than the dry, and being imperfect in the fermentation they take a much longer period to deposit their sediment or lees. It is necessary to rack them off oftener than the dry wines, as the only means to

purify them and bring them to perfection, as no other help can be given them by the farmer to this end, such as putting brandy to them, &c., which must seldom or never be done unless to save them, and then a very small quantity can be given them after the first or second year, or on the first racking of them off the lees; if they should appear imperfect in any respect, about a jar of brandy, or even less, say about two or three gallons. Dry wines, at every racking off, if they appear defective, should have a small portion of brandy applied to them, besides the casks being washed or rinsed with it. The must of the sweet wines lies the same time in the casks as that of the dry wines, and the process the first year, is the same, only the casks are not washed with brandy. These, as well as the dry wines, should be racked off early in the autumn and spring, and clear settled weather should be chosen for it. In the second and third year, beginning in September, sweet wines ought to be racked off twice in the autumn and twice in the spring,—say about September and November, and about March and May.

The dry wines, if with the farmer or holder, for sale to the managers or exporters, after the first year should be racked off only twice a year; in the spring and autumn, say about March and September.

Amontillado Wine.—A pale, thin, nutty, dry, delicate wine. It is produced alike from all dry grapes, in small quantity, and generally accidental, although there are some soils and vines,—the Palomino especially,—which more than any others, yield such a wine. It is regarded something of a phenomenon in wine making, for no farmer can be positively certain that the grapes, when gathering, will produce Amontillado, although he may so conjecture from past experience, and the Palomino grape predominating, the knowledge of the soil and the state of the vintage. New vines hardly ever are found to yield any of this description of wine. The soil about San Lucar being higher than that of Xeres, a greater quantity, but of a weaker quality, is annually got there. They can with more certainty too, calculate upon having it in consequence of this, and the manner in which they get through the vintage. It is never ascertained to be of the Amontillado kind before the first process of fermentation is over, and frequently not even then.

The difference which this wine assumes from the general character of dry white wines, is supposed to be the consequences of a more perfect or peculiar fermentation than the other butts of the same original nature, undergoing fermentation in the same cellar and for the same period, as its positively becoming so is not in the power of man, nor are the actual causes known to any person positively.

When all the wines are racked off the lees in February or March, those casks are generally recognized which may prove to be Amontillado. This operation repeated also with them in April or May, but not in September, if it is really believed they are Amontillado, which is ascertained by its being very pale, white and bright, as if it had no farther deposit of matter or lees to make; the taste is nutty, and not strong, devoid of the spirituous, and rather brisk; it must not be moved or racked off into other casks after being thus ascertained. About this time a nata, or kind of unctuous coating comes on the surface of the wine, which is at first whitish, by degrees gets yellow, and then dark coloured. The white thin coat or scum shows itself about September; it becomes yellow a twelvemonth

afterwards, or thereabouts; and the year following of the dark colour, and continues longer if left to itself.

It would appear that Nature does all for this wine, for being free of spirituous matter and all lees so early, it forms this coating for itself to preserve it from acidity through the influence of the air. Care should be taken not to disturb the wine in the casks by tasting it often and letting the air in; and the bung should be tighter in the cask than with other wines, which is only loosely left in the bung hole. It always improves more in small casks or butts than in the larger kind of casks. The wine being so much weakened by the peculiar and great fermentation, requires rest, and will not suffer to be moved or racked off as the others.

ON FERMENTATION.

As observed to proceed in the musts in Xeres de la Frontera, and after they become wines:

The degree of heat most suitable to the opportune and complete first or vinous or tumultuous fermentation of the musts, should range between 65° and 75° of Fahrenheit's thermometer, and if not lower than 70° all the better.

The duration of this process varies according to the quality of the grapes, their species, and state of maturity, and the degrees of heat prevailing. It should be continuous, because when interrupted by any casualty or mismanagement, the quality of the wine is injured. As this is manifest, I have always wondered why every vineyard has not, as an adjunct to its wine presses, a well ventilated cellar, fit to contain the vintage of a year; for the bringing as they are pressed—the musts—to the cellars in town, must more or less obstruct the regular progress of the fermentation, refrigerate the must, and bring on again the interrupted phenomenon.

The sensible or violent fermentation goes on for periods more or less, according to the quality of the musts, their more or less perfection, as regards the proportion, the substances or elements of the grapes (the sugar, tartar, malic acid, colouring part, mucilage, and volatile spirit), which ferment, hold to each other. The seasons favouring the perfection of these elements of the grapes, and their carefully gathering them at the point of maturity, in about a month or six weeks the violent stage of the fermentive process terminates. Formerly the new wines were sought after at about St. Andrew's day (30th November), not only for fixing their prices, but from their being considered sufficiently fermented and clear for racking them off their lees, to deliver to purchasers. For some time past, however, perhaps from experiencing that generally the sensible fermentation was not so complete as it should be, the period of commencing to buy is prolonged to February or so, and buying goes on for months afterwards; but this custom, although no doubt safer for the purchaser, affects harmfully the quality of the wine purchased later, because for the sake of economizing expense, the growers, who do not rear their wines themselves, keep them on the lees for months longer than ought to be, with due regard to the preservation of their natural quality, age, and quantity likewise.

In confined, small, and little ventilated cellars, the sensible or vicious fermentation, proceeds so slowly and imperfectly that the wines never turn out well, however perfect as musts, they come from the press.

The sweet wines, or musts, of the Muscatel and Pedro Ximenes grapes, from the greater quantity of saccharine principle in them, undergo much less fermentation. I mean this is not so brisk, and they take more time to deposit their sediment or lees; the vinous fermentation, though not so active, going on longer than that of the dry wines, which are those the preceding paragraphs apply to.

The thickness or body of the musts, commonly indicates their quality, and the principal agents of the perfect sensible fermentation, (such as opportune atmospheric air and heat, the perfection of the grapes in their every substance and principle, &c.) being in harmony and complete, I found the peso-liquor, or aerometer, of Baumé, when the musts were taken from the press to mark:—

Baumé. Specific Gravity.

Of Muscatel, from 19° to 21° - 115 to 117
Pedro Ximenes, 18°, 21° - 114, 117
Dry wines in general, 14°, 17° - 110.7, 113.4

As the fermentation advances, the density of the must, as it is being converted into wine, goes on diminishing, the figures going down gradually so low as 2° and 1°, and even under 0°, or water as much as 1° and 2°, as the wine proceeds to perfection through the evaporation of the most subtle substances and the precipitation of the most dense and heavy, in the ratio that those which form the wine go on intimately combining. The saccharometer used in England for ascertaining the specific gravity of worts, mashes, liqueurs, &c., I find to answer the same purpose as Baumé's peso-liquor, in ascertaining the body of musts, and I make the application of it to wines of all ages, of some use, occasionally on the score of body and combinations.

I have, I believe, noted all that need be said respecting the sensible or violent fermentation as it proceeds after favourable seasons for, and opportune gathering, and pressing of the grapes. The thriving of vineyards, and the good quality of the grapes, depend upon a just proportion, a perfect equilibrium, between the water which must nourish and the heat which alone can facilitate the elaboration of the plants. Unusual or excessive rains, as well as heats, and one or the other unseasonably (to say nothing of the mischief done now and then by the frosts and strong Levant winds), without being so consequently, affect prejudicially the quality of the grapes, this, the vinous fermentation of the must, and both the wines, as a matter of course.

After the vinous or tumultuous fermentation is passed, the wines - now no more must, and separated from their lees - undergo another, which is called the insensible, or imperceptible; so that, in fact, the fermentation ceases apparently only, not really, and to have good wines it must be allowed to continue, and will, for more or less years to fulfil its purpose completely, according to the quality of the wines which by this process clarify themselves, improve, soften, strengthen, and acquire fine odour with age, and lose the harsh and strong smell and taste of new wines.

At certain times of the year, every year, all wines turn up something, and more visibly discover the commotion of the insensible fermentation, exposing them until they get into fair age to become sour, and this more particularly at the period the vine blossoms in the spring, and when the grapes begin to ripen in the harvest.